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WROUGHT IRON TUBE FOR CABLE RAILWAYS.

In view of the success attending the introduction of the cable railway in San Francisco and Chicago, there can scarcely be any doubt that it is the street railway system of the future, destined to supersede the present mode of propelling street cars by horse power, owing to its many advantages, such as greater speed, economy of motive power, and occupancy of much less space in the streets.

The engraving we present in this issue illustrates a new system of tube for cable railways.

This tube is made up sections bolted together, each section being a self-contained girder, the upper chord of which has a continuous slot, admitting the grip bar to the interior of the cable tube. Each section consists of two opposite side plates, the upper portions of which are bent so as to converge toward each other. To their upper edges are riveted angle bars of proper shape, far enough apart to form the continuous slot above referred to. The lower edges of these side plates are connected with angle bars to a bottom plate. The side plates, and preferably also the bottom plate, and the top and bottom angles, extend throughout the entire length of the section, thus forming a self-contained girder, of which the upper angles form the top chord, the side plates, the webs, and the lower angles and bottom plate the bottom chord.

To provide against lateral pressure on the sides of the tube from the pavement and from vehicles crossing over the top chord angles, a series of braced frames are riveted to the sides and bottom of the tube, consisting of angle ribs, lower transverse channel beams, or heavy angles, and inclined brace bars, riveted to the upper end of the angle ribs, and to the ends of the lower transverse channel beams or angles.

The body of the girder or tube is about 33 inches deep; the transverse channel beams are 8 inches deep. The clear width of the body of the tube in its lower portion is 12 inches, and the length of the transverse channel beams is 40 inches; being the widest part of the tube at any point. The sections are made in convenient lengths of about 16 feet, the connection between two consecutive sections being made by bolts through angle ribs at their ends. Thus a continuous tube or conduit is formed, complete in itself.

The work of laying the tubes is extremely simple. A trench is dug 3 feet deep from the surface and 3 feet 8 inches wide, for a distance of a block at a time, into which are lowered the tubes, and, after having been properly leveled up and bolted together and connected to the track stringers by three-quarter inch round rods attached to the angle ribs on the tubes, the work of closing up the ditch begins. First the space under and alongside of the tube is filled with concrete to within a foot of the surface of the street, sand to the depth of several inches is then thrown on, and the whole paved over with Belgian blocks.

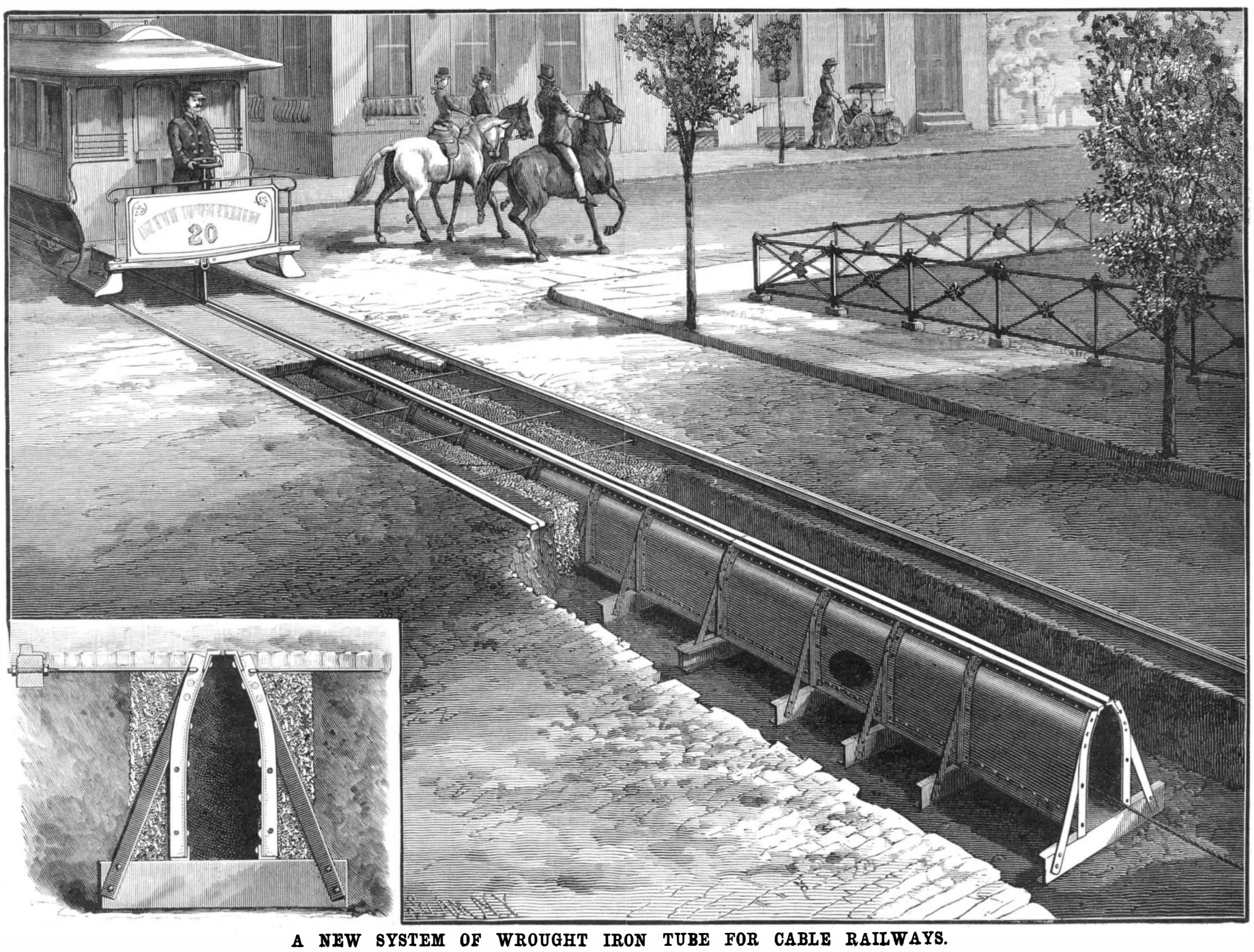
Every alternate tube is provided with a manhole in one of the web plates, affording access to the tube for the purpose of introducing or removing the cable, oiling the sheaves, etc. At each of these manholes a chamber is made in the concrete, accessible from the street through a square opening alongside the track, which is covered with a cast iron lid.

It will be seen that the whole process of laying these tubes is so very simple, that the advantages of this system of tubes are quite apparent. The limited width of the trench, which leaves the tracks wholly intact, enables the construction of the cable railway to proceed without interfering with the running of the horse cars, or requiring any temporary side tracks or movable bridges, where existing lines of horse railway are changed into cable railway. In this connection Mr. George Rice, Chief Engineer of the Cable Division of the Union Passenger Railway Company, of Philadelphia, which company is now completing the laying of 20 miles of this tube, writes in response to an inquiry:

"I have made a careful examination of the different cable roads in California and Chicago, and I believe our Philadelphia system of cable tubes is the best for several reasons. It is simple in its construction, and consequently cheaper than any of the existing systems of tubes that have any claim to permanency. These tubes can be laid more rapidly, and for construction on an existing line of horse railway, without interference with the traffic, this system has no rival.

"It would be impossible to build a cable line, such as is in use in Chicago or on Market Street, San Francisco, without side tracks or some device, such as a movable bridge, on which to pass the cars over the break in the street. In a narrow street the side tracks are not admissible, and the bridge device would be a cumbersome and expensive means of keeping the cars in motion over the work," etc.

Any further information in regard to the tube, relating to the construction, cost, etc., can be obtained on application to the inventor, A. Bonzano, Chief Engineer of the Phœnix Bridge Company, at Phœnixville, Pa. This system of tubes is patented in the United States and Great Britain.



A NEW SYSTEM OF WROUGHT IRON TUBE FOR CABLE RAILWAYS.

Dynamite.

At a recent meeting of the Engineers' Club, of Philadelphia, Mr. J. J. De Kinder presented an illustrated description of a method of removing condemned machinery by dynamite, as practiced by him in the case of the side levers of the old Cornish pumping engine at Spring Garden Water Works, Philadelphia, which weighed 29,000 pounds each. Drilling, tapping, and breaking each beam in two, with a half pound of dynamite, and without injury to the building or other machinery, occupied thirteen hours. Even had dispatch been unnecessary, it might have taken two weeks to do this work by the ordinary methods.

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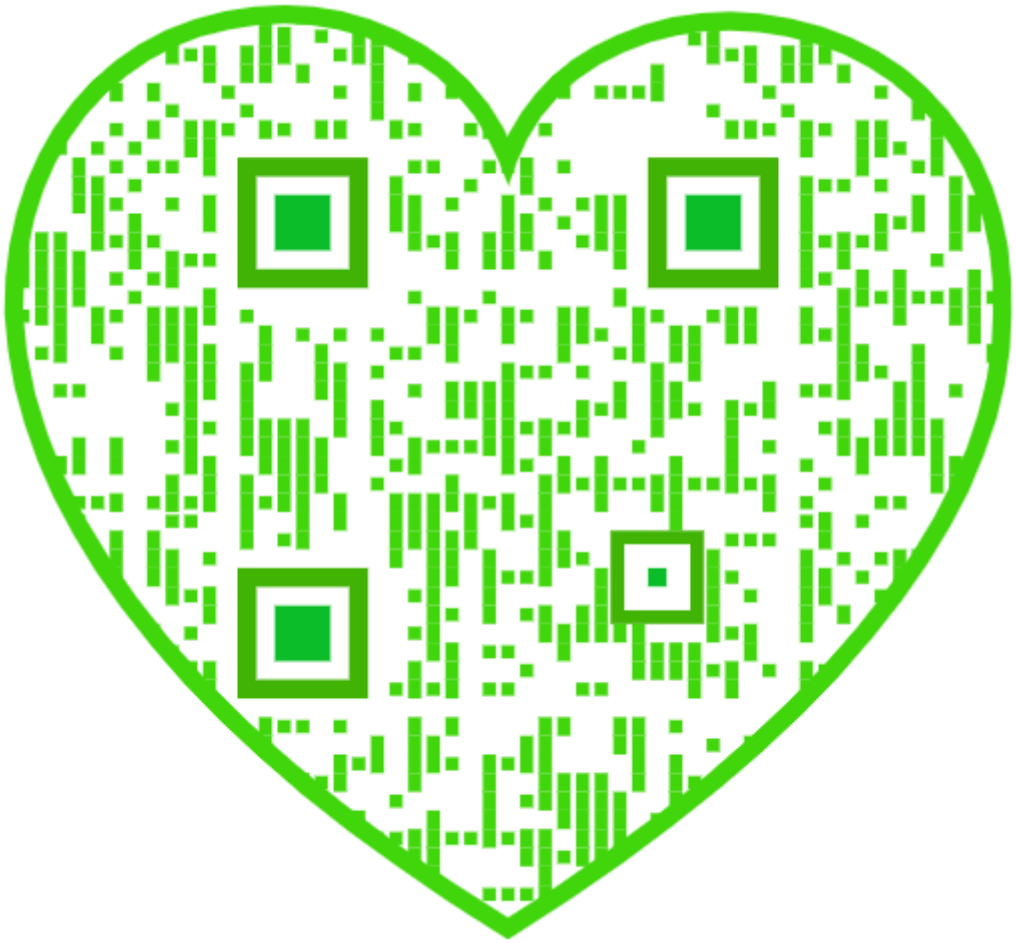

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Contents.

(Illustrated articles are marked with an asterisk.)

Acid, liquid carbonic. 353
Acid tests, sulphuric..... 353
Alcohol in glutinous liquids..... 354
Ants, African 356
Arch, whalebone, a*..... 359
Bad water, bad cloth 356
Blast, big, a 357
Boat, canal, McDonald's*..... 354
Business and personal 362
Buttons, pearl, manuf. of..... 355
Carpet beating..... 358
Cellar, damp, a, to cure..... 353
Colosseum, the..... 361
Cuff holder, Bishop's*..... 360
Door keeper, electric, Woehrle's* 354
Dynamite 351
Earache, treatment of..... 357
Earth, temperature of..... 360
Egg case, folding, Ruge's*..... 354
Expansion, to determine 360
Fox, Arctic* 359
Gas, cooking with..... 360
Gas in iron and steel..... 361
Guide for holding the fingers in writing* 355
Hammer, steam, improved*..... 358
Hydrophobia, antidote for..... 355
Industry and veracity 360
Insect, lead-boring, a..... 357
Inventions, engineering 362
Inventions, index of 363
Inventions, mechanical 362
Inventions, miscellaneous 362
Inventors, some words to..... 357
Iron and steel, optical tests for... 353
Iron, softening and hardening.. 352
Jerseys the favorite..... 356
Lightning flash, photographing*.. 355
Manufacturing, state of..... 352
Marble, removing silver stains.. 356
Nails, porcelain headed..... 352
Negatives, gel., intensifier for.... 352
New books and publications..... 362
Notes and queries..... 362, 363
Petroleum industry, the..... 352
Pipes, brass, explosion of..... 358
Pipes, cast iron, corrosion of..... 357
Plants, poisonous, antidotes for. 357
Salt in western New York..... 358
Skating, military 359
Sponges, bleaching..... 360
Star of Bethlehem, the..... 356
Stove pipe connection, Laube's*. 354
Sunsets, red, the..... 359
Surgery, remarkable..... 354
Toronto, Canada, 1834-1884..... 355
Tube, iron, for cable railways*... 351
Valve gear, cut-off*..... 355
Vines, protection from frost..... 356
Vise, hand, watchmaker's*..... 330
Visibility, present limit of 357
Water, purifying by motion..... 361
Wheat cleaner, French, a..... 360
Wells, artesian, in New York.... 353

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 440,

For the Week ending June 7, 1884.

Price 10 cents. For sale by all newsdealers

PAGE

I. CHEMISTRY AND METALLURGY.—The Union of Bodies by Pressure.—Treating of experiments with various metals and minerals made by W. Spring 7024

II. ENGINEERING AND MECHANICS.—The Fastest Train in Great Britain 7020
Gatterall and Birch's Hydraulic Liquid Elevator.—1 figure..... 7022
Hydraulic Propulsion.—By SIDNEY WALKER BARNABY, C.E.... 7022
Gatling Gun.—With description of the latest forms of these guns, and 12 illustrations..... 7022

III. TECHNOLOGY.—Illuminating Gas from Sawdust.—By GEO. WALKER 7023
The Elasticity of Silk.—Silk fiber compared with wool and other fibers..... 7025

IV. PHYSICS, ELECTRICITY, ETC.—Lechne and Lerksch's Thermograph.—2 figures 7017
On the Magnetic Susceptibility and Retentiveness of Iron and Steel.—By J. A. EWING.—Paper read before the British Association 7017
Amperemeters, Voltameters, and Measurers of Energy at the Vienna Exhibition.—With 11 engravings..... 7018
Clamond's New Incandescent Gas Burner.—2 figures 7019
Electric Motor for Single-rail Railway.—3 figures 7020
The Heat Action of Explosives.—Abstract of a lecture read by Capt. A. NOBLE before the Institution of Civil Engineers 7021

V. ARCHITECTURE, ART, AND ARCHÆOLOGY.—Panel from the Communion Railing in the Cathedral at Verdun.—An engraving.... 7024
Nottingham Mechanics' Institute New Reading Room.—With engraving 7025
Relics of the Santa Barbara Indians.—By REV. STEPHEN BOWERS..... 7025
The Treasures and Antiquities of Salamis, Cyprus.—Treating of the work of Major Di Cesnola 7026

VI. NATURAL HISTORY.—Submarine Explorations.—Mollusks collected during the cruises of the Travailleur and Talisman.—With engraving..... 7026
Reptiles and Music.—Reptiles' love of harmony utilized by snake-charmers.—With engraving 7028

VII. HORTICULTURE AND BOTANY.—Chrysanthemum Anemones.—With 4 engravings..... 7027
A New Spiræa.—With engraving..... 7027

VIII. MEDICINE AND HYGIENE.—Prof. Pasteur's Laboratory for the Study of Rabies.—His manner of studying the virulent diseases of animals.—With 4 engravings..... 7015
Improved Ambulance 7016
A New Dental Amalgam.—Composition of most dental amalgam alloys, and the objections to the same.—A "definite alloy" necessary.—Alloys produced by electrolysis..... 7016

IX. MISCELLANEOUS.—What it is to Read Music.—By Prof. CHAS. F. KROEH.—Reading instrumental music.—Why a singer cannot read notes like a player.—The doctrine of mental effects.—The Tonic Sol-fa and other methods..... 7028
"Red Sky."—Addenda.—By ISAAC P. NOYES..... 7030

THE STATE OF MANUFACTURING.

Visits during the first half of May to the manufacturing towns in four counties of Connecticut show a condition of business activity much more favorable than the general reports in the newspapers, taken from all parts of the country, would seem to justify. Perhaps much of this difference is to be attributed to the varied character of the industries in those portions of the one State visited. Machine tools, guns, sewing machines, machine screws, bicycles, small tools, builders' hardware, bench hardware, nuts and bolts, screw taps and dies, butt hinges, pumps, drop and lever presses, steam, water, and gas fittings, and many other branches of productive work of which the general public are in continual need are in the usual demand. In no one department of productive industry is there evidence of a permanent falling off in demand, although there is a tendency to crowd down the prices. So, on the other hand, there is no unusual demand for the productions of any department. In some instances the hours of labor have been temporarily shortened; in others (two) the number of men has been curtailed. But in the first instance a return to the original full time is shortly expected, and in the other the men were discharged because of a glut in the specialties they produced. One establishment that in early spring shortened its hours of labor is now working overtime in its most important departments.

Some annoyance has been caused by the debates and delays in Congress on the matter of a tariff on foreign productions as affecting home manufactures, and some of the manufacturers attribute the falling off of orders to the uncertainty which this state of Congressional business produced. But there is a better feeling than there was during the pending and threatening of the Morrison bill, and it seems possible that the old notion of a presidential election year proving to be one of general business depression may be shown to be unfounded.

PORCELAIN HEADED NAILS.

One of the familiar illustrations of the benefit of rapid machinery in producing articles of use combined with elegance, is in the manufacture of the ornamentally headed nails used for picture hanging and similar purposes. The heads of these nails are of porcelain or glass, held in a gilt brass setting, and the shanks are of iron wire. The heads are moulded from opaque porcelain or transparent glass, and the settings are made from sheet brass in the dies of a press. A disk of brass is cut from a sheet, and a small hole made in its center. The disk is drawn down through the center of the die, forming a tube-like neck which is afterward tapped in a machine, thus forming a nut for the reception of the threaded head end of the wire shank.

The press forms the setting into a cup shape for the glass or porcelain head, and this, when inserted, is held in position by having its edges turned in over the head by a press. The wire shank is pointed in a rotary press which draws the wire down to a point in dies or scores that form the pointed portion four sided. On two of these sides a film or sprew is left that is removed by a trimming press.

The formation of the screw thread on the other end of the wire shank is somewhat interesting. The thread is not cut with dies—in fact, it is not cut at all. It is rolled up from the material of the shank, and the threaded portion becomes larger than the original wire. There is a fixed die in a press, the die having been milled on a slant to represent the V-threads of a certain pitch. The die is perfectly flat, and these scores are simply cuts of a V-form running diagonally across it. Another die exactly like the fixed one is attached to a reciprocating arm, so as to traverse across the fixed die. Between these dies the shank is passed under pressure, and the result is a perfect thread at the rate of at least one hundred gross per day, the only attendant being a boy.

SOFTENING AND HARDENING CAST IRON.

Questions have lately been asked as to the possibility of altering the texture or changing the qualities of cast iron by heating and chilling. In the respect of resistance to the superficial changes which are induced on steel by heating and sudden chillings, cast iron stands alone. It is amenable to the gradual influences of heat, but it will not contract nor harden, like steel or wrought iron, under sudden changes from heat to cold. And yet hard cast iron may be annealed, as it is done daily by tons, the heat being supplemented by the pyrogenous oxide of iron, the hot oxidized scale, such as is seen at the base of the blacksmith's anvil. It can be annealed also, if the articles are small enough, by being heated in a bituminous coal fire, and then buried until cool in a bed of the coal siftings. This sort of annealing is entirely unlike that for hard wrought iron or obdurate steel, as in these cases only clean charcoal is to be used, any taint of sulphur being a source of injury. But in annealing hard cast iron the softening qualities of the sulphur contained in bituminous coal is what is required. Some of the most intractable specimens of cast iron, no larger in diameter than a pipe stem, that refused to yield in a genial charcoal fire when packed with bone, lime, and charcoal, softened to usable condition by one heating in bituminous coal.

As to hardening of cast iron there is no ordinary process that is generally convenient, except that of casehardening. In this the cast iron article should be polished as well as finished—the surface being made as homogeneous as can be—so that the flux of casehardening be given as large a surface for action as possible; for the composition of cast iron is a honeycomb instead of a solid; and it is not even a series of layers of fibers, as is wrought iron, or of a network of fibers, as is cast steel, but it is a mass of material of which pure iron itself is not always the largest part. Recent improvements, however, have given the pure metal a preponderance over the foreign palpable matter and the air spaces. But this constitution is not common.

Even heating is necessary to caseharden cast iron; and yet the heat must be less than that allowed for wrought iron and low steel, for at much less than the white heat for wrought iron or the "high heat" for carbonized steel, the cast iron would disintegrate. The cast iron should be heated to a soft red heat and then sprinkled with powdered prussiate of potash and sal ammoniac in proportions of two of prussiate and one of sal ammoniac, and then immediately plunged into a cold water bath. It will not do, in the matter of casehardening cast iron, to return the iron to the fire, or to use the flux as a paste. Put it on as a powder, and plunge immediately into cold water.

The Petroleum Industry.

From recent statistics it appears that there are 20,000 producing oil wells in Pennsylvania, yielding at present 60,000 barrels of oil a day. It requires 5,000 miles of pipe line and 1,600 iron tanks, of an average capacity of 25,000 barrels each, to transport and store the oil and surplus stocks. There are now nearly 38,000,000 barrels of oil stored in the region in tanks. This oil would make a lake more than one mile square and ten feet deep. The money actually invested in petroleum production since 1860 is estimated to be more than $425,000,000, of which $200,000,000 was capital from New York city. Since 1880 more than $12,000,000 has been used in building iron tanks, and nearly as much in pipe lines, all by one corporation. The tanks cost on an average $8,000 each. A 35,000 barrel tank is 90 feet in diameter and 28 feet high; 100 tons of iron are used in constructing one. The annual loss from lightning by the use of iron tanks is very great, as they form an attractive path to earth for electricity.

The speculative transactions in petroleum represent more than $400,000,000 annually. The lowest price crude petroleum ever brought was 10 cents a barrel, in 1861. In 1859, when there was only one well in existence, Colonel Drake's Pioneer at Titusville, the price was $24 a barrel. Besides the 5,000 miles of pipe line in use in the oil regions, there are in operation 1,200 miles of trunk pipe lines connecting the region with Cleveland, Pittsburg, Buffalo, and New York, and lines building to Philadelphia and Baltimore. In the line between Olean and New York 16,000 barrels of oil are transported daily. These lines are all the property of the Standard Oil Company, except one between Bradford and Williamsport, Pa. The Standard employs 100,000 men. The product of its refineries requires the making of 25,000 oak barrels of 40 gallons each, and 100,000 tin cans holding 5 gallons each, every day The first American petroleum ever exported was in 1862. Charles Lockart, of Pittsburg, sent nearly 600,000 gallons to Europe in that year, and sold it for $2,000 less than the cost of transportation. In 1883 nearly 400,000,000 gallons were exported, for which $60,000,000 were returned to this country.

Simple Intensifier for Gelatine Negatives.

The mercury intensifier for gelatine plates, now largely used by photographers, has been somewhat improved by Mr. H. J. Newton quite recently.

The advantages claimed for it are its simplicity, speed, and in giving to the negative a good color. The intensifier, combining mercury, iodide of potassium, and hyposulphite of sodium, sometimes gives to a negative a yellow color, which makes it a slow printer. The solution will not keep well, but soon precipitates.

Mr. Newton's formula overcomes these objections. He first takes 10 grains of bichloride of mercury, pulverizes it in a mortar, and dissolves in 10 ounces of water. He next dissolves 190 grains of iodide of potassium in 3 ounces of water, and gradually pours the same into the mercury solution. A red precipitate occurs, but will be redissolved when the whole amount of iodide of potassium has been added.

The 13 ounces of concentrated solution thus formed is now diluted by the addition of 24 ounces of water. The intensifier will keep clear for a long time, and so retain its strength.

To intensify, Mr. Newton pours a sufficient quantity of the intensifier into a tray, and immerses in the same the dry or dried negative. The action of the intensifier takes place in a few seconds, and the intensification is completed in two or three minutes.

The plate is then washed and immersed for a few seconds in a very dilute solution of hyposulphite of sodium, again washed, and dried. Negatives in which there was very little detail in the shadows have been very easily brought up to good printing density with this intensifier. It is essential that the hyposulphite of soda shall be eliminated from the plate before intensification. To avoid an extended washing for that purpose, Mr. Newton quickly dissolves out the hypo from the film by pouring over the latter, after fixing, a solusion of 5 to 10 grains of nitrate of lead to the ounce of water.

Its action is easily observed by the formation on the film of a milky precipitate, which may be easily washed off.

AMONG the recent patents is one for the combination of a holy water font and a poor box.

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To Cure a Damp Cellar.

A correspondent inquires of the editor of the *American Architect* what remedy he would suggest for curing a damp cellar.

The difficulty to be overcome, presents the questioner, in a new house is the wet cellar. Conditions present, concrete not strong enough to resist the hydraulic pressure through a clay soil. No footings under wall (which are of brick). No cement on outside of wall. The water evidently, however, forces its way through the concrete bottom.

(*a*) Will reconcreting (using Portland cement) resist the pressure of water and keep it out?

(*b*) If not, will a layer of pure bitumen damp-course between the old and new concrete do the work?

(*c*) Will it do any good to carefully cement the walls on the inside with rich Portland cement, say 3 feet high, to exclude damp caused by capillary attraction through the brick wall?

In reply to the above queries the editor gives the following hints, which are equally applicable to builders of new houses as to those occupying old houses with damp cellars:

It is doubtful whether even Portland cement concrete would keep back water under sufficient pressure to force it through concrete made of the ordinary cement. The best material would be rock asphalt, either Seyssel, Neufchatel, Val de Travers, Vorwohle, or Limmer, any of which, melted, either with or without the addition of gravel, according to the character of the asphalt, and spread hot to a depth of three-quarters of an inch over the floor, will make it perfectly water tight. The asphalt coating should be carried without any break 18 or 20 inches up on the walls and piers, to prevent water from getting over the edge; and if the hydrostatic pressure of the water should be sufficient to force the asphalt up, it must be weighted with a pavement of brick or concrete. This is not likely to be necessary, however, unless the cellar is actually below the line of standing water around it.

This, although an excellent method of curing the trouble, the asphalt cutting off ground air from the house, as well as water, will be expensive, the cost of the asphalt coating being from 20 to 22 cents a square foot; and perhaps it may not be necessary to go to so much trouble. It is very unusual to find water making its way through ordinary good concrete, unless high tides or inundations surround the whole cellar with water. If the source of the water seems to be simply the soakage of rain into the loose material filled in about the outside of the new wall, we should advise attacking this point first, and sodding or concreting with coal tar concrete, a space 3 or 4 feet wide around the building. This, if the grade is first made to slope sharply away from the house, will throw the rain which drips from the eaves, or runs down the walls, out upon the firm ground, and in the course of two or three seasons the filling will generally have compacted itself to a consistency as hard or harder than the surrounding soil, so that the tendency of water to accumulate just outside the walls will disappear; while the concrete, as it hardens with age, will present more and more resistance to percolation from below.

For keeping the dampness absorbed by the walls from affecting the air of the house, a Portland cement coating may be perhaps the best means now available. It would have been much better, when the walls were first built, to brush the outside of them with melted coal tar; but that is probably impracticable now. If the earth stands against the walls, however, the cement coating should cover the whole inside of the wall. The situation of the building may perhaps admit of draining away the water which accumulates about it, by means of stone drains or lines of drain tile, laid up to the cellar walls, at a point below the basement floor, and carried to a convenient outfall. This would be the most desirable of all methods for drying the cellar, and should be first tried.

Sulphuric Acid Tests.

As we all know, this acid is one of the most commonly used for technical purposes; it also forms an important part in the manufacture of carbonic acid gas. The large and constantly increasing consumption renders it necessary that it should be of a pure nature. Ingredients which happen to be found in sulphuric acid during the process of manufacturing may not be of any consequence for some purposes, but will for others. It should not contain any arsenic, subnitric or sulphurous acid, nor any chlorine; which ingredients act more or less injuriously.

For carbonic acid gas we require, without doubt, a product which should be entirely free from the above ingredients; and although manufacturers may wish to deal fairly with the consumer in every way, it may sometimes happen that one or more of the above impurities are found in it. Without special test they cannot be detected. It is, therefore, advisable to always test purchases of sulphuric acid for their purity, and get convinced that it is in such a condition that it will not injure the product to be made. A simple test is for this purpose of great advantage, and the following method will be of some use in places where no chemist is employed:

A small portion of the sulphuric acid is evaporated on a platinum sheet, which is subsequently brought to a red heat. Good sulphuric acid should not leave any residue; if there is any, it is generally sulphate of potash, or soda, or even lead. These are derived from the manufacture, and cannot be classed among adulterations. We may say here that on account of the cheapness of the sulphuric acid it never is willfully adulterated, but *may* contain many foreign ingredients.

A little sulphuric acid is diluted with water, and a few drops of concentrated muriatic acid added; if the solution, which was clear before, becomes milky, it indicates the presence of lead, which can be more safely identified by letting a current of sulphureted hydrogen gas pass through the liquor.

Another ingredient which is often found in sulphuric acid, particularly such products as are made from pyrites, is arsenic. For the manufacture of carbonic acid gas, it is especially required that the acid be entirely free from arsenic, and also nitrous acid and subnitric acid. Arsenic is detected by the so-called Marsh test. If mixed with water and granulated zinc, hydrogen gas is liberated, which should not contain any trace of arsenic. The hydrogen gas is ignited, and the flame allowed to strike a cool porcelain plate, on which, if arsenic is present, metallic arsenic is deposited.

Subnitric or nitric acid may be detected by throwing a small piece of copperas in the questionable acid; if it shows a brown coloration where it touches the liquid, the presence of the above impurities is indicated.

Chlorine or muriatic acid, also injurious for many purposes, is detected by adding a few drops of nitrate of silver into the diluted sulphuric acid; a precipitate or a milky appearance of the mixture shows the presence of chlorine or muriatic acid.

Subnitric acid, derived from the manufacture, is shown by adding iodide of potash and starch mixture to the sulphuric acid; a blue coloration shows subnitric acid.—*Nat. Press and B. A.*

An Optical Test for Iron and Steel.

The question of distinguishing between iron and steel still engages considerable attention on the Continent, where a Committee of Arts and Manufactures, specially appointed by the French Government to examine the subject, has caused much astonishment and dissatisfaction, by maintaining the faculty of tempering as the sole distinctive characteristic of steel. The committee are believed to be reconsidering this judgment; and, meanwhile, the *Revue Industrielle* observes that researches are being prosecuted with a view to discover some simple method of examination which will serve for the recognition of cast metal. The importance of this question, both from the trading and technical standpoints, is universally recognized wherever people who pay for steel wish to see that they get it; but it is peculiarly pressing in all protectionist countries, where differential duties are imposed on various brands of iron and its varieties.

M. Alfred Evrard, Director of the Firminy Steel Works, has carefully studied the matter, and has presented the results of his observations to the French Society of Mineral Industry. The French Ironmasters' Association admit that "the word 'steel' is to be attributed not only to products, not cast, which take a temper, but also to all cast malleable products, whether they are susceptible of tempering or not." According to this definition, there is no such thing as cast malleable iron. The question resolves itself, therefore, into one of detecting, by some reliable process, the traces of welding in welded products. A series of striking experiments was conducted with this object at Firminy. A number of lengths of iron and steel wire of different qualities were cut into pieces, reunited, heated together in a forge to a yellow oxidizing temperature, and tempered in cold water. After this operation the wire was heated again to a cherry red, then well hammered, and finally beaten into a flat band of from 0·4 to 0·8 millimeter thick. If during its handling the wire cooled, it was reheated. The drawing out accomplished, the portion drawn was again returned to the fire, heated to an oxidizing yellow, at which temperature it was kept for a minute, and then very slowly cooled in the fire. When it became reduced to dark red, the metal was plunged into cold water. The sheets were afterward polished on both sides, a bright finish not being desired, but only so much of the metal removed to obliterate all trace of the oxidation produced by the intense heat. This operation suffices to show the lines of severance of iron in welded samples; but it is insufficient to absolutely distinguish the metal, if produced from blooms.

After being polished, the sheets were dipped in nitric acid, in order to show the grain of the metal under this energetic attack. The result showed that steel has a uniform surface, and preserves a gray appearance; the attack of the acid bit into the metal equally all over the surface. Iron, on the contrary, showed a rough surface, the attack of the acid being very irregular. The metal showed brilliant characteristic grains ranged in longitudinal lines beside other portions showing a gray surface like steel. The "bloomed" iron also showed black bands, due to contained impurities. The welds of mixed irons appeared very prominent. The distinctive character which permits of the recognition of a welded from a cast product is the appearance of brilliant, shining spiculæ. In the bloomed metal these are very numerous, and form broken longitudinal lines. In fagoted bars these bands follow the welds all along their length. Another experiment conclusively showed that the presence of bright spiculæ is due to welds. A number of bars of extra soft cast steel were welded like iron, and afterward drawn out into a sheet, as already described, when not a trace of welding appeared until the acid test was applied, which immediately distinguished them by lines of brilliant spiculæ perfectly separable in appearance from the gray metal in which they appeared. Thus the presence of lines of bright grains in metal is due to welding; they enable us to distinguish clearly between a product welded and a product of casting—that is to say, to distinguish between iron and steel.

Any user of metal can employ the proceeding already described—to roughly polish the surface of a suspected metal (a sample flattened under the hammer, if possible), and test it with acid for bright lines. M. Evrard, however, adds a few remarks on the *rationale* of the process, as carried out at Firminy. The first operation—the tempering of the iron at an oxidizing yellow heat—was to open the welds of the metal. The wires of hard steel broke under this treatment. The second operation—the forging of the wires—like the preceding, opened the metal, which, spread into thin sheets, offered a large surface for examination. The third operation—reheating and tempering of the sheets—by keeping the metal at a yellow heat for a certain time, the texture taken by it under the hammer was destroyed, and it was caused to crystallize in large grains. The tempering at dark red rendered the welds visible. For the fourth operation—the acid test—it is necessary that the samples should be polished on the surface, in order that the test should be equal at all points. The test should also be a severe one; and, in order to secure this, the following arrangement might be made: The samples should be placed in a glass jar, partly filled with nitric acid of from 10° to 15° Baume. The attack by the acid is at first very energetic, and after exposure in this way for ten or fifteen minutes, the samples may be withdrawn, washed in water, and immediately wiped dry. The volume of dilute acid should not be too large in comparison with the samples, or it will not rise sufficiently in temperature to act in the strongest possible way upon the metal. These operations require neither laboratory nor skilled operator; they are applicable to all descriptions of iron or steel samples, from the finest wire to pieces cut from structural bars; and they furnish certain and indisputable results.

In order to display in the most striking manner the indications thus obtained, M. Evrard makes use of two Molteni lenses, for projecting an image of the tested surfaces upon a screen, whereby the bright spiculæ and lines of welding are rendered very conspicuous. The practical value of the tests, however, to users of iron and steel does not depend upon refinements of this order.

Artesian Wells in New York.

While the city authorities are debating how to provide a sufficient supply of water for the millions that are and are yet to be inhabitants of New York, private individuals are solving the problem for themselves in a very practical way. Almost all the brewers of the city have artesian wells or are sinking them. Several dry goods and other business firms are also adding to their liquid stores in the same direction. Tracy & Russell are boring on the sidewalk of their big building on Greenwich Avenue, and have gone as deep as 815 feet to find a flow of brackish water averaging about eight gallons a minute. They have been at it about six weeks. They expect to sink a couple of hundred or more feet before they come to a good supply of clear, sweet water. George Ehret, on East Ninety-second Street, is also sinking a well on his premises, and at a depth of 575 feet finds a flow of about 1,000 gallons an hour of brackish water. At a depth of 430 feet Mr. Button, the driller, struck a stream of living water from the East River, the trend of which was from northeast to southwest. He thought it flowed from the vicinity of One Hundred and Sixth Street toward the rocky ridge of Fourth Avenue, and then took a turn, and a few blocks south of Ninety-second Street flowed back to its source. In the well that is being sunk for Mr. Ehret it is found that the rise and fall of the water correspond with the ebb and flow of the tides in the river. That there is an open channel between the well and the river was also proved by the bringing up in pieces of a fish about ten inches long which had been cut by the drill.

At the depth of about 520 feet another stream was struck. The water is brackish, and is evidently from the river. At the depth of 575 feet it was of the same character, but with an increased mixture of sweet water. At the depth of 800 feet Mr. Button expects to strike below the limestone bed of Ward's Island, and to obtain a abundant supply of good drinking water. This will be tapped at its own level for brewing purposes, while the brackish water will be tapped at the higher level for lavatory and other uses.—*The Iron Age.*

Liquid Carbonic Acid.

It appears, as a result of the labors of Dr. Raydt, of Hanover, that liquid carbonic acid is speedily destined to take its place as an article of commerce, susceptible of important chemical and mechanical applications. The liquid is contained in wrought iron or steel cylinders, holding 10 liters, in which this quantity of liquid, under a pressure of 36 atmospheres represents 450 times its bulk of gas. Dr. Raydt's improvements comprise not merely the commercial production of liquid carbonic acid, but also relate to the arrangements for disengaging it at a regulated pressure. When the price of this liquid is sufficiently low, it will find many uses wherein great pressure is required to be applied within a small or confined space. At Krupp's Steel Works liquid carbonic acid is used to compress cast steel while cooling in moulds. For this purpose, by heating the reservoir of liquid to 200° C., a pressure of 1,200 atmospheres has been obtained. In this form also pure carbonic acid in considerable quantity, for chemical purposes, may be easily stored and transported.

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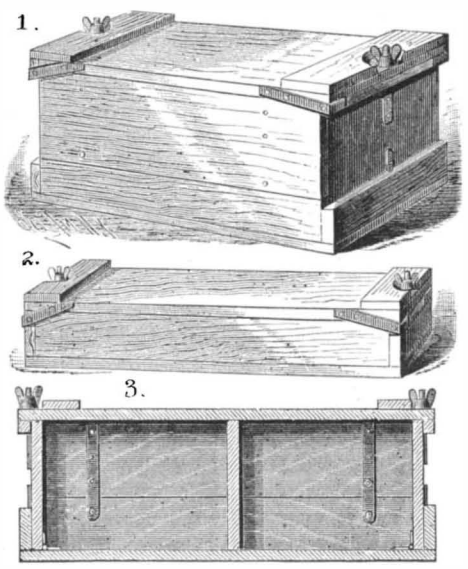
Alcohol in Glutinous Liquids.

The author puts 100 to 200 grammes of the substance into a roomy flask, fitted with a cork having two perforations. In the one is a bent tube which merely passes through the cork and is connected at the other end with a condenser and a receiver. Through the other passes a tube bent at right angles, its longer end passing down nearly to the bottom of the flask, while the other is connected with any convenient steam generator. The flask is fixed in a water bath, and by means of the current of steam all the alcohol is quickly driven out of the glutinous mass and into the receiver.—*E. Borgmann.*

FOLDING EGG CASE.

The egg case herewith illustrated is the invention of Mr. W. G. Ruge, of Washington, Mo., and can be folded very compactly so as to occupy little space while being returned to the shipper. Two side boards and two end boards are fastened to the bottom, the side boards being a little higher than the others. Ends are hinged to the bottom in such a manner that they can be folded down, and when raised their outer surfaces will rest against the inner surfaces of the end boards. Upon the upper edges of the side boards are placed sides of such a height that their upper edges will be flush with the edges of the ends. The sides are held in place by bars having hooks on their lower ends to catch on studs on the side boards. At each end of the cover is an under cleat so arranged as to project beyond the ends when the latter are raised. Secured to the ends are screw pins, which pass through the cover and receive winged nuts. Lateral displacement of the box is prevented by braces secured to the side edges of the cover, as shown in Fig. 1, which is a perspective view of the case. Fig. 3 is a longitudinal sectional elevation through the same.

When the box is to be filled the ends are swung up, the sides are held on the side boards by the bars, the cover is



RUGE'S FOLDING EGG CASE.

placed on, and the nuts screwed down. When the box is to be folded, the cover is removed, the ends are swung down, the sides are removed and placed on the folded ends, the cover is placed on the side and end boards, and the nuts turned on the screw pins projecting from the end boards. The side boards are made higher than the end boards on account of the cleats projecting below the surface of the cover. Fig. 2 shows the case folded.

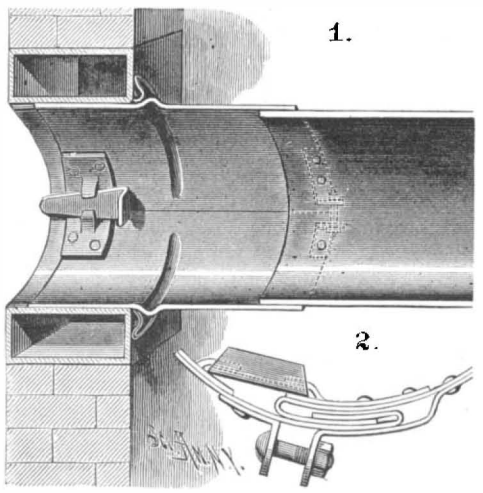
Remarkable Surgery.

A remarkable case of recovery from what was thought to be a fatal gun shot wound brought many eminent physicians to Bellevue Hospital, this city, last week. A young German who shot himself in the head some months ago had been the subject of a number of remarkable surgical operations. The bullet entered the brain immediately above the nose and passed through the head, lodging in the base of the brain, from which it was removed by boring a hole in the skull. A drainage tube was inserted as a drain for the blood and matter from the wound. Subsequently the tube was withdrawn, the wound healed, and insanity did not result.

The operation for a new nose in plastic surgery was not long since performed in Bellevue Hospital, with more than ordinary success. The French and Italian method of building up a nose from the cheeks or the arm has little to recommend it, because, there being neither bone nor cartilage, the flesh sinks into the face, a shapeless mass. In the Bellevue Hospital case, Dr. Sabine used the middle finger of the left hand as bridge and septum, taking off three phalanges. This he covered with pieces of flesh from the cheeks. The patient, a messenger in the hospital known as "Tommy," was suffering from the terrible malady called "lupus." He is now much improved in appearance, and a living example that the bridge of the nose as well as the nostrils can be replaced by a skillful hand.

STOVE PIPE CONNECTION.

In an invention patented by Mr. Godfried Laube, of Huron, Dakota, the accidental withdrawal of the pipe from the chimney or the pushing of it in too far is avoided by the tight joints made between the pipe and the thimble or chimney; the connection being made with an adjustable



LAUBE'S STOVE PIPE CONNECTION.

joint, the diameter may be adapted to pipes and thimbles of different sizes.

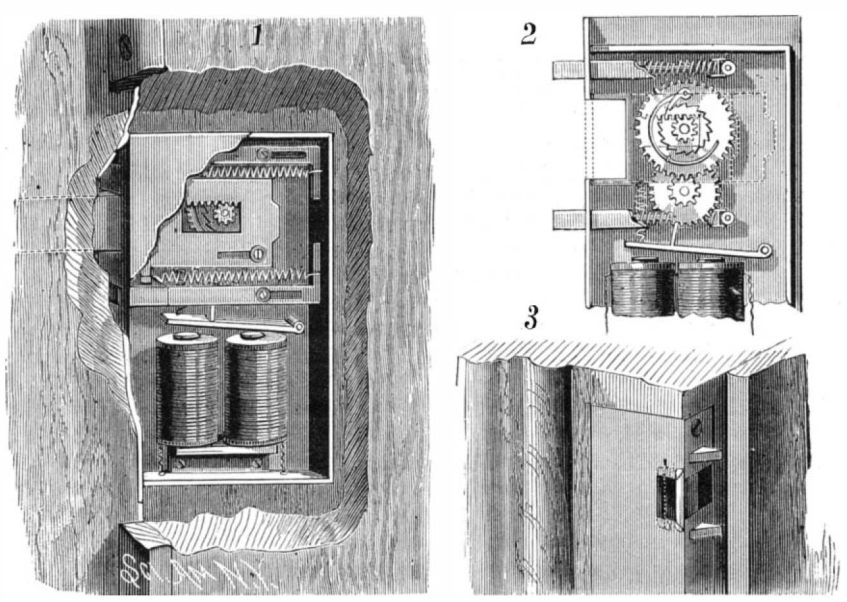
A thimble of the ordinary construction is arranged in the chimney. The joint of the connection is made by folding over two opposite edges of the iron. On the inside of the end of the connection, on each side of the joint, is a lug between which passes a wedge having a lip on the wide end, as shown in Fig. 1. By driving the wedge in tightly the connection is expanded and made to bind within the thimble. Upon the outside of the connection near its other end are two right angled lugs—one on each side of the joint—adapted to receive the bolt and nut as indicated in Fig. 2, which is a sectional view. The end of the stove pipe being placed within the connection, the joint is drawn up by screwing the nut, and the end of the pipe is held firmly. Unscrewing the nut frees the pipe, and taking out the wedge permits the withdrawal of the connection.

ELECTRIC DOOR KEEPERS.

The electric liberating door holder herewith illustrated is designed for the outside doors of buildings generally known as French flats. It has been patented by Mr. A. C. Woehrle, of 2187 Third Avenue, New York city.

The inclosing shell is secured to the door post by screws in the ordinary manner. A sliding keeper, having right angled portions, is held in the shell by a screw passing through a slot. In closing the door the lock bolt rubs against the outer part of the keeper and drops behind the edge, thus keeping the door closed. The inner part of the keeper is furnished with a slot which is formed with a rack which, in connection with the jaws, pinions, cog wheels, and ratchet (shown plainly in Fig. 2), serves to lock the keeper forward, in the position shown in Fig. 3, except when the lower pawl is drawn downward against the tension of the spring by passing a current of electricity through the electro-magnets.

Sliding bolts formed with beveled ends are placed in slots in the case, and their inner ends are held by screws passing through slots, Fig. 1. The bolts are held pressed forward by coiled springs, and are connected with the sliding keeper by coiled springs, as clearly indicated in Fig. 1. When the door is open the bolts stand in the position shown in Figs. 2 and 3, with the beveled ends protruding from the slots in the shell; but when the door is closed the bolts will be forced inward, thereby compressing the springs shown in Fig. 2, and distending those in Fig. 1, and the latter, when the lower pawl is drawn down by the magnets to free the cog wheel, serve to draw the keeper within the shell and away from the front of the bolt, thus liberating the door so that it may be forced open by the action of the spring attached to it in the ordinary way. The parts then assume their original position. When closed, the door cannot be opened except by operating the bolt directly, by door knob or key, or by passing a current of electricity to the magnets. Circuit wires connect the magnets with the poles of a battery and with buttons situated in the different stories of the building.

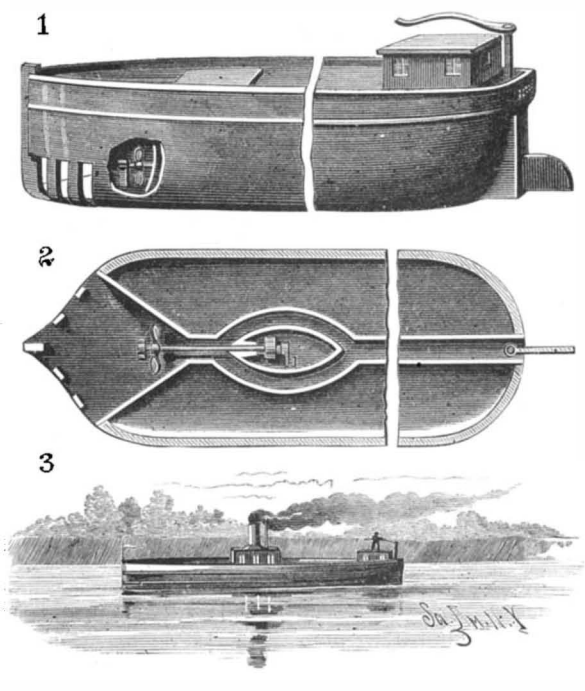


WOEHRLE'S ELECTRIC DOOR KEEPER.

CANAL BOAT.

A tunnel is formed in the bottom of the boat from front to rear, the ends being open. At the bow of the boat the tunnel terminates in a lateral enlargement, and a grating or screen is formed to prevent floating objects from entering. Near the front end the tunnel has two curved branches—one on each side—between which a compartment is formed as shown in the plan view, Fig. 2. A shaft is journaled in a standard in the compartment, and a standard in the enlargement. On the front end of the shaft is mounted a propeller wheel, and on the inner end is a crank on which are coupled means for revolving the shaft.

Water, drawn in at the bow by the screw, passes through the tunnel, and being discharged at the stern, assists in propelling the boat. It is claimed that as the water is drawn in at the front of the boat, the bow need not force the water to one side, and thus no billows are formed to wash out the banks of the canal. As the boat advances, the discharged water fills the space just vacated by the boat.



McDONALD'S CANAL BOAT.

This invention has been patented by Mr. Angus McDonald, P. O. Box 17, Au Sable, Mich.

Krakatoa.

The size of Krakatoa was formerly 33½ square kilometers; of that 23 square kilometers have subsided, and 10½ square kilometers remain extant. But on the south and southwest side the island has been increased by a large ring of volcanic products, so that the size of New Krakatoa is now, according to the survey, 15⅓ square kilometers. The size of Long Island was formerly 2·9 and is now 3·2 square kilometers. Verlaten Island has become much larger; it was formerly 3·7 and is now 11·8 square kilometers in size. Of the Poolsche Hoedje nothing remains.

In the place where the fallen part of Krakatoa once stood there is now everywhere deep sea, generally 200, in some places even more than 300 meters deep. It is remarkable that in the midst of this deep sea a rock has remained which rises about 5 meters above its surface. Close to this rock, which is certainly not larger than 10 meters square, the sea is more than 200 meters deep. It is like a gigantic club, which Krakatoa lifts defiantly out of the sea.

HOUSEKEEPERS are frequently annoyed by oil marks on papered walls against which thoughtless persons have laid their heads. These unsightly spots may be removed by making a paste of cold water and pipe clay or fuller's earth, and laying it on the surface without rubbing it on, else the pattern of the paper will then likely be injured. Leave the paste on all night. In the morning it can be brushed off and the spot will have disappeared, but a renewal of the operation may be necessary if the oil mark is old. The experiment will be likely to result most satisfactorily on plain papers, or that with the least number of colored figures.

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DEVICE FOR HOLDING AND GUIDING THE FINGERS IN WRITING.

A metallic rod, A, made about two inches longer than the width of the hand, and having each end rounded, is passed under the hand as shown in Fig. 1. To the lower portion of the rod is attached a ring, B, encircling the fourth finger. The ring, C, upon the first finger, is provided with a loop through which the rod is passed; this allows the device to be adjusted to hands of different sizes.

The use of this device does away with the habit of doubling under the third and fourth fingers and of allowing the hand to rest on its right side upon the desk; the penholder cannot fall below the knuckle joint. The thumb, fore and second fingers are free for any movement, and as the writer has complete command of his fingers he is not inclined to hold them too straight or the penholder too tightly. While a correct position is at once assumed, the writer is bound to keep his wrist off the desk.

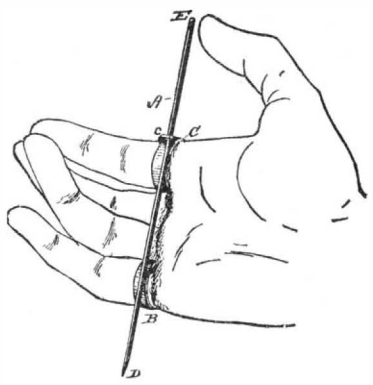


Fig. 1.

Fig. 2.

DEVICE FOR HOLDING AND GUIDING THE FINGERS IN WRITING.

This invention has been patented by Ignaz Bergman, of Fort Madison, Iowa.

An Antidote for Hydrophobia.

The celebrated French chemist, M. Louis Pasteur, claims to have discovered a complete antidote for hydrophobia. In an interview with a Paris *Figaro* correspondent he is reported as saying:

"Cauterization of the wound immediately after the bite, as is well known, has been more or less effective, but from to-day anybody bitten by a mad dog has only to present himself at the laboratory of the Ecole Normale, and by inoculation I will make him completely insusceptible to the effects of hydrophobia, even if bitten subsequently by any number of mad dogs.

"I have been devoting the last four years to this subject. I found out, in the first place, that the *virus rabique* loses its intensity by transmission to certain animals, and increases its intensity by transmission to other animals. With the rabbit, for instance, the *virus rabique* increases; with the monkey it decreases. My method was as follows: I took the virus direct from the brain of a dog that had died from acute hydrophobia. With this virus I inoculated a monkey. The monkey died.

"Then with the virus—already weakened in intensity—taken from this monkey I inoculated a second monkey. Then with the virus taken from the second monkey I inoculated a third monkey, and so on until I obtained a virus so weak as to be almost harmless. Then with this almost harmless virus I inoculated a rabbit, the virus being at once increased in intensity.

"Then with the virus from the first rabbit I inoculated a second rabbit, and there was another increase in the intensity of the virus. Then with the virus of the second rabbit I inoculated a third rabbit, then a fourth, until the virus had regained its maximum intensity. Thus I obtained virus of different degrees of power. I then took a dog and inoculated him, first with the weakest virus from the rabbit, then with the virus from the second rabbit, and finally with the rabbit virus of maximum intensity. After a few days more I inoculated the dog with virus taken directly from the brain of a dog that had just died of acute madness. The dog upon which I had experimented proved completely insusceptible to hydrophobia. The experiment was frequently repeated, always with the same successful result.

"But my discovery does not end here. I took two dogs, and inoculated them both with virus taken directly from a dog that had just died of acute hydrophobia. I let one of my two dogs thus inoculated alone, and he went mad and died of acute hydrophobia. I subjected the second dog to my treatment, giving him the three rabbit inoculations, beginning with the weakest and ending with the strongest. The second dog was completely cured, or rather became completely insusceptible to hydrophobia."

M. Pasteur then went to a kennel and caressed a dog that had undergone this latter operation. "*Voyez!*" said Mr. Pasteur, "*comme il est bien gentil.* Whoever gets bitten by a mad dog has only to submit to my three little inoculations, and he need not have the slightest fear of hydrophobia."

Manufacture of Pearl Buttons.

At Springfield, Mass., there is a manufactory of pearl buttons, and a reporter of the *Republican* stepped into the factory the other day, and he tells briefly what he saw:

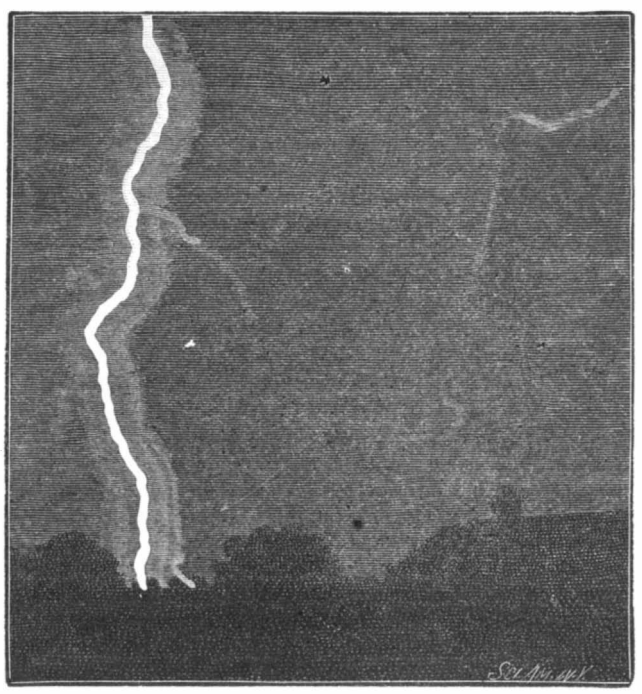
The Springfield Pearl Button Company has now had a year's life, and if increase of working force is any criterion, it is a vigorous infant. It is unique among New England button making industries in that it uses only simple machinery, depending mainly on the trained hands and eyes of its twenty-five or thirty workmen for the perfection of its products. The marine shells from which the mother of pearl is obtained—shells of the pintadina variety, coming from the East and West Indies, California, and, in fact, all quarters of the world—are taken as they come packed, are rinsed in water, and are then ready for turning. The shell is made up of the mother of pearl inside, this being of a creamy or varied coloring, and a thinner outer layer of a bony texture. The shell is pierced through a number of times by a hollow boring tool, fitted to a common lathe, some dozens of small disks being the result. Each disk then goes through three or four or sometimes a half dozen more operations at the hands of the men standing in a line at one work bench, each having a lathe and a three-cornered file, sharpened to suit his work. The bony part is cut from the disk and the button shape given it while revolved by the lathe against the sharp steel held in the workman's hand, no gauge being used. Some of the buttons are grooved with a few lines on the face, and a few holes are punched in each. Part of the buttons are subjected to a mysterious coloring operation in a revolving box, but the best grades are finished in the natural colors. The polishing is mainly done by hand.

The whole process is very quick, and the method has the great advantage of being immediately adapted to any style of button desired, no change in machinery being required, but merely a fresh adjustment of flesh and blood. All sizes of ordinary buttons are turned out, as well as some "collar buttons," though no fancy articles are made. The light-colored material is the most valuable. Fifty cents a pound is paid for the rough shells, but the buttons are worth from one to seven or eight cents each.

PHOTOGRAPHING A FLASH OF LIGHTNING.

The accompanying engraving was made directly from a photograph sent to us by Mr. W. C. Gurley, of Marietta Observatory, who writes as follows:

"The reproduction of a flash of lightning by photography would, a few years since, have been deemed quite an impossibility, but the introduction of the rapid bromo-gelatine process has rendered it not only possible but comparatively easy of accomplishment.



The accompanying photograph is from a negative taken by myself during a thunder storm which passed several miles south of the observatory on the evening of May 4.

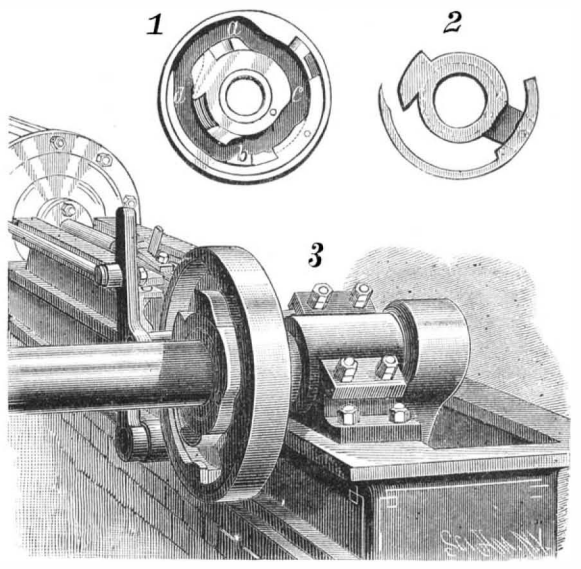
Wheatstone has demonstrated by direct experiment that the duration of a single flash of lightning cannot possibly exceed a millionth of a second. That a photograph showing the detail of the one mentioned could be taken in this inappreciably short time seems quite wonderful, not to say incredible. The plate employed was one of Cramer's extra rapid, and developed with strong pyrogallic developer.

It will be observed that the flash is not of the usually depicted zigzag form, and that it seems to be alternately contracted and expanded in its passage through the atmosphere.

Taking the interval between the flash and the report, I estimated its distance from the camera to have been about five miles."

CUT-OFF VALVE GEAR.

The valve is operated by a rod connected with a rocking lever provided with a pin which enters an irregular or eccentric adjustable groove in a disk mounted on the crank shaft. The disk is flanged and is provided with an eccentric track, half of which is formed by the inner surface of the flange, and the other half by a cam ring (shown in the lower part of Fig. 2) held to slide between the remaining half of the flange, and a ridge projecting from the surface of the disk, parallel with and close to the flange. One end of the ridge is united to the flange, but the other end is open to permit the cam ring to pass in and out. A segmental ridge of varying thickness projects from the inner surface of the disk, and also forms an eccentric track.



McCARTER'S CUT-OFF VALVE GEAR.

A neck projects from the disk around the central aperture, and between this neck and the first ridge is formed a segmental slot. Upon the outer side of the disk is a collar, around which fits an eccentric ring (shown in the upper part of Fig. 2) provided with a cam projection, diametrically opposite which is a hole for a screw. This ring is held in the space between the collar and the segmental ridge. Fitting loosely in the outer collar is a ring secured to a plate which extends to the periphery of the disk. A screw passes through a hole in the plate, through the slot in the disk, and into the eccentric ring. A roller, mounted on a pin in the rocking lever, passes into the irregular groove formed by these parts. The cam ring, the eccentric ring, and the plate projecting from the ring encircling the collar move together. Fig. 1 is a face view of the disk with the parts in position, the shaded portion showing the path of the roller.

When the piston is at that end of the cylinder farthest from the shaft, steam will be admitted to the rear of the cylinder, and the piston will be moved toward the shaft, the slide valve remaining motionless. The projection, *c*, then strikes the roller, the lever is shifted, and the steam is cut off. The slide valve does not move until the stroke has been completed, when the end, *a*, of the ridge strikes the roller, swings the lever and rod in a direction from the shaft, thereby shifting the valve so as to admit steam into the front end of the cylinder. The valve again remains stationary, until the end, *d*, of the cam ring strikes the roller, when the steam is cut off. During the stroke toward the shaft the valve is opened to admit steam by the projection, *b*. The points, *a* and *b*, which govern the admission of steam are fixed, but the points, *c* and *d*, which govern the cut-off are movable. The cut-off mechanism can be so adjusted that steam will be cut off at any desired part of the stroke. As will be readily seen, the device can be applied to stationary or marine engines or locomotives, and will work equally well with either a slide or other form of valve.

This invention has been patented by Mr. M. J. McCarter, of Norristown, Pa.

Toronto, Canada, 1834—1884.

Toronto is one of the few cities outside of the United States on our northern border which seem enough like ourselves in the go-aheadativeness, intelligence, and thrift of its inhabitants to really form an integral part of the Great Republic, instead of forming, as it does, a pleasant neighbor under a "foreign" flag. The city celebrates its semi-centennial from the 30th of June to the 5th of July next, and on one side of the card containing the elaborate programme are views of the "then" and "now"—one being a pleasantly located hamlet, with windmill and Indian canoe in the foreground, and the other a great and handsomely laid out city, with the evidences of a large lake commerce and prosperous industries. The jollification should be a hearty one.

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Jerseys the Favorite.

The manner in which the Jerseys have been bred of late years serves as a lesson to breeders of all classes of stock. It is well known that the most experienced breeders flattered themselves that their knowledge of the points required in regard to form, texture of hair, color, escutcheon, and general appearance would enable them to annually improve the herds and increase their powers of production. But, despite all the care exercised in breeding for external marks, the *qualities* of the animals did not follow the arbitrary rules and regulations laid down for the breeders as a system to be pursued, and it became evident that the influences governing the adaptability of the animals to practical purposes surrounded certain families without regard to the desires of the breeders in other respects. There is nothing remarkable in some of the best cows, so far as outward appearances are concerned, but there is an inherent quality transmitted to succeeding generations that does not diminish by being passed from one to the other.

While the cows of admired form were receiving the highest consideration at the parish shows, they were beaten at the pail by some that could not compete with them except in production, and the attention of breeders was directed to the fact that *actual* improvement depended more upon the ability of the cow to produce largely than upon exterior indications, and after following the lines to which such pedigrees traced, the system of breeding was changed to that which was sure to increase production and make the descendants more valuable.

We find that the greatest value is now placed on cows possessing the blood of ancestors that were remarkable for production only, and even the bulls are discarded unless their pedigrees are royal and trace back to the fountain head graced by some favorite valuable cow. Coomassie is handed down through her sons, and her grandsons bring fabulous prices in all quarters. Eurotas, valuable and noted as she was, is still more highly prized through her sons, Duke of Darlington and Pedro. We find close inbreeding strictly adhered to as long as the blood of Rioter, Jupiter, and Prize can be secured, and no out-cross is allowed unless it is one that is known to be an improvement.

As we stated before, the lesson is a good one. The same course in breeding Jerseys may be followed with advantage in breeding sheep, swine, and horses. It is careful selection, with the aid of beaten paths to tread, and if persisted in will surely lead to the best results. The only objection is the tendency to breed closely, but so far there apparently seems to be no damage done, yet the rule should not be too imperative. The best cows have always been produced by inbreeding, and such animals are usually capable of transmitting their qualities to their descendants, but care should be exercised in order to avoid loss of vigor and strength. Happily, so far, the Jerseys are as vigorous and productive as ever, and the improvement seems to better with each generation.—*The Farm and Fireside.*

Protection of Vines from Frost.

Monsieur G. Jouanne, in a recent number of *Le Gaz*, says it is widely known what losses are occasioned to viniculturists in wine producing territories through the destructive agencies of the early spring frosts, as in the course of a few hours the prospect of a plenteous harvest is blighted. The symptoms of a hoar frost, usually manifesting themselves shortly before sunrise, unfortunately can only be discovered or detected by careful, vigilant watching throughout the entire night—even then it is difficult to foresee them, as this sort of supervision cannot be prolonged to any considerable extent without entailing upon the watcher great fatigue and decided personal inconvenience.

The preventive appliances hitherto used must be ready at any and every moment; and among such appliances may be mentioned stationary covers, small planks, straw mats, metal disks, as having been employed for protecting the vines from the killing hoar frost. All of these being in the nature of stationary covers, often possess but little value, as from any sudden change in the course of the wind their utility as a shield is good only in one direction.

The formation of artificial clouds, produced by the burning of tar, is, without doubt, one of the best protectors that can be used; and as gas engineers are directly interested in advocating and applying this system, we believe it will not be void of interest to them to learn the method adopted successfully in experimenting with tar smoke for the purpose of protecting vines against frost.

A row of flat bottomed, open mouthed porcelain vases, each containing 5 to 6 kilogrammes (12 to 14 pounds) of tar, is placed around the borders of the land to be protected. The vases are usually set from 20 to 25 meters (66 to 81 feet) apart. To facilitate and hasten the lighting a piece of oakum or a bunch of straw saturated with petroleum is stuck in the middle of the filled tar vase; with a similar piece of burning oakum, fastened to the end of an iron rod, the contents of the whole row of vases can soon be ignited. Almost immediately a thick, heavy smoke arises, continuing to ascend during the progress of combustion; and being blown by the wind, from whichever quarter it comes, soon spreads over the whole field. As it is generally during a calm that the frosts are most dreaded, the absence of the wind only tends to increase the thickness of the smoke that issues from the vases and hovers among the vines; it is most efficacious, therefore, at the time it is most needed. The vases should be provided with a lid, made of a simple piece of wood, when it is intended to place them in position in advance of the time of their being needed, in order that their contents may not be exposed for too long a period to the action of the elements. These tar pots, arranged in this manner, and on the side of the field most exposed to the prevailing winds, are ready to be at once put to the use of protecting the vines as soon as the first symptoms of frost are felt.

In order that the vine grower may be notified of the near approach of the frost, the following is suggested. A mercurial thermometer should be armed with a float and an electric contact so arranged that when the column of mercury would fall to a degree corresponding with a temperature approximating near to a hoar frost, the circuit of the pile attached to the thermometer would be closed, and thus put in action an electric alarm clock. This clock could be stationed in the proprietor's sleeping apartment, or in that of his superintendent; the thermometer might be placed in the field, or in any convenient location outside the house, in such a position as to be at once affected by any decided change in temperature. By this means the frost itself would sound the signal of alarm, and all would be in readiness to avert the threatened danger.

The Star of Bethlehem.

The theory concerning the "Star of Bethlehem" is based on a poetical foundation, having little to support it. In the year 1572 Tycho Brahe, a Dutch astronomer, discovered a new star near Caph in the constellation Cassiopea. It increased in brilliancy until it was as bright as Venus, and could easily be seen at noonday. It continued to shine brightly for a month, then gradually grew dim, and in 16 months disappeared from view. It was looked upon as a new creation or a sun on fire, and the general opinion was that it would never again shine in the star depths.

Forty years later the telescope was invented. When it was turned to the position in the heavens occupied by the blazing star, a minute star was found near the identical spot. This telescopic star is still there, and is doubtless the same one that blazed forth in 1572. The discovery that it existed led astronomers to search astronomical records, and it was found that similar bright stars had appeared in the same region of the sky in 945 and 1264. Counting back three periods from 945, we are brought to the near vicinity of the birth of Christ. Observers gifted with poetic fancies have naturally connected the two events, and have inferred that the star in the east, pointing to the place of the Nativity, was a sudden outburst of this wonderful star. For this reason it has received the name of the Star of Bethlehem.

About 24 of these temporary stars have appeared in the last 2,000 years, subject, like the star in Cassiopea, to sudden outbursts followed by a return to their normal insignificance. They are now classed as variable stars, subject to sudden outbursts due to eruptions of blazing hydrogen, and which are followed by long periods of quiescence. According to this theory, the star of 1572 is a variable star, with a period of a few more than 300 years. The last period was 308 years, if the bright star of 1264 was one and the same; we may therefore hope for a repetition of the incomprehensible phenomenon in the immediate future. The star was due in 1880; if it appears at all it will surely blaze forth by 1885. There is a possibility, therefore, that the long-lost Star of Bethlehem, the Pilgrim Star, the star of 1572, or Tycho Brahe's star—for it is known by all these names—will once more become a shining wonder in the sky. Such a celestial visitor will be warmly welcomed by astronomers, and far more acceptable than a great comet spanning the heavens with its gossamer tail.—*Providence Journal.*

African Ants.

The bashikonai ants must be a terrible plague. They travel night and day, in armies miles long. The elephant and gorilla fly before them; the black man runs for his life so soon as the ants are seen. It is related by a traveler that as he was going up one of the mouths of the Zambesi, he saw a whole village suddenly deserted by the inhabitants, who fled with all they could carry off, a proceeding which, as there was no foe in sight, rather puzzled him, till he found they were fleeing from the ants. When these ants enter a hut, they clear it of every living thing in a few minutes. Huge cockroaches, almost as large as mice, centipeds, mice, and rats are instantly devoured. A strong rat is killed in less than a minute, and in another minute its bones are picked. A leopard, dog, or deer is soon dispatched and devoured, for they kill by their numbers. They are quite half an inch long, and one variety is so strong that it will bite pieces clean out of the flesh. They possess, however, one meritorious quality—they mortally hate, and, whenever they can, put to death the mischievous white ants which make such destruction in houses. In addition to these and the sand ants, which bite like scorpions, leaving a distressing pain behind them, there are several varieties of flies which sting horribly, such as the igogonai—small gnats—whose bites go through the tough hide of the negroes, causing a terrible itch; the ibolai—flies or gnats—which sting as though with a needle, and whistle as they dash at you; the richouma, which fill themselves with your blood before you know they are there, and then leave an itching that lasts for hours, varied at intervals by certain sharp stabs of pain; the sloway, or nest-building flies, not quite so big as a bee, which cling to a man even in the water, and assail the natives with such ferocity that if a canoe, by chance, touch one of their nests, the men instantly dive overboard.

Bad Water, Bad Cloth.

The following facts related by the *Deutsche Wollen Gewerbe* convey an instructive lesson. A German mill, almost exclusively engaged in the weaving and dyeing of army cloth, received many complaints of the cloudiness of its scarlet cloths. These cloths are required to be dyed with cochineal, and so simple is the operation that the proprietors of the works were puzzled to know the cause of the defect. Every measure was tried to obtain a clear and uniform shade. From 100 to 150 pieces were dyed at once. The weaving was so reorganized that the dyeing went on continuously. The cloth was singed and washed in the piece in order to remove every particle of impurity, and then passed through a bath of bran.

Despite all this care the goods came out with as many cloudy spots as ever, and, driven to desperation, the proprietors took steps to have their cloths dyed at a neighboring works. Before sending them the thought suggested itself that perhaps the cause of the damage lay in the water used for the vats. This was taken from wells sunk through alluvial deposits into the rock below, and upon analysis it proved to be pure.

Attention was next turned to the steam, and there was found the cause of all the trouble. A portion of it condensed, treated with chloride of tin and gradually raised to 90° Centigrade, formed on its surface a thin layer of grease of a blackish gray color, that could be removed with a glass spatula. A solution of stannate of soda and lime now added to the water revealed the presence of indigo. Pushing the investigations, the cause of its presence was soon found out. Three boilers, connected together, draw their feed water from wells which derived their supply by a ditch leading from a neighboring stream. On the banks of this stream was a wool bleachery, and between it and the dye house a machine shop. Little by little, and seemingly unobserved, a portion of the drainage from the bleachery, in which 10,000 pounds of wool were cleansed, and, for the most part, bleached daily, found its way into the ditch which supplied the wells that fed the dye house boilers. As the steam from them heated the contents of the dye vats by being turned directly into them, the dyes became impure and the dyeing clouded. This indicates how drinking wells may sometimes be contaminated.

Removal of Nitrate of Silver Stains from Marble.

The Liebig statue at Munich, which was set in place less than a year ago, is of marble, and its beautiful color tempted some dirty rascal to try to spoil it. For this purpose a liquid containing in solution permanganate of potash and nitrate of silver, two of the substances which produce the most ineffaceable stains upon cloth, was squirted with a syringe over the statue, covering it with black spots, which penetrated deeply into the soft stone. As soon as the injury was observed, competent chemists were set at work to devise means for repairing it. An analysis of scrapings from the surface of the stained marble showed the presence of silver and manganese, and the form in which they were employed was readily guessed, since the nitrate of one and the sodium salt of the other are the only soluble compounds of them in common use.

The nature of the stains being discovered, it was necessary to invent a method for converting the substances which constituted them into others which could be removed from the stone, and the experts resolved to attempt their transformation into sulphides, with a view to their subsequent solution and removal by the aid of cyanide of potassium. In order to secure the continuous application of sulphur necessary for the complete conversion of the spots, fire clay saturated with sulphide of ammonium was plastered over them, and renewed at intervals until the action was complete. The paste was then removed, and the marble washed with pure water until all the alkaline sulphides were removed. Another fire clay paste, saturated with solution of cyanide of potassium, was then prepared, and applied to the spots in the same way as the first. The sulphides formed in the marble were dissolved by the new reagent, and the solution absorbed by the clay; and on the final removal of the paste the spots were found to be perfectly removed.

THE sixteenth and seventeenth annual report of the Trustees of the Peabody Museum of American Archæology and Ethnology (Vol. III., Nos. 3 and 4) has just been published, and in addition to the list which it contains of valuable additions to the museum at Cambridge, is a series of papers upon the researches carried on under the auspices of the museum in different parts of the country. These papers, many of them, are very interesting, and call attention to the careful study which is being made of the customs and habits of our Indian tribes. The character of the work that has been carried on is shown forth in the titles of some of the articles, viz.: On the Social and Political Position of Woman among the Huron-Iroquois Tribes, by Lucien Carr; Notes upon Human Remains from Caves in Coahuila, Mexico; White Buffalo Festival of the Uncpapas; Religious Ceremony of the Four Winds; Shadow or Ghost Dance; The Wa-wan or Pipe Dance of the Omahas, etc. The description of the ceremonies and festivals of these tribes is a valuable acquisition to what literature we already have upon these different subjects, and the reports upon the discoveries that have been made in the burial mounds of these tribes, and the examinations that have been made upon the human remains found within the mounds, constitute by no means the least valuable feature of the work.

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Correspondence.

A Lead Boring Insect.

To the Editor of the Scientific American :

Eighteen months ago a tank was lined here with 4-pound sheet lead, and after being in use about six months the owner was troubled by its leaking. On examination two small holes were found, supposed to be made by nails; these were repaired, but after a short time it leaked again, and another hole was found. So I tore off a small piece of the lead, and found that the holes had been eaten through both the wood and *lead* by a small insect, of which I send you a specimen. As I have had twenty-five years' experience in plumbing, and never before heard or knew of anything of the kind, I thought it might be interesting and also instructive to your numerous readers if you could give some information on the subject. WM. F. ASHENHURST.

Little Falls, N. Y., May 16, 1884.

Ans.—The insect referred to in Mr. Ashenhurst's communication proves to be *Phymatodes dimidiatus*, Kirby (family Cerambycidæ or longicorn beetles), which in the larva state infests the oak. Several insects of various orders, but more especially coleoptera and their larvæ, are known to bore through lead or other soft metal if forced to do so, but the fact is not of common occurrence. In the case related by Mr. Ashenhurst, the larva of the *Phymatodes* lived in the wood of the tank before this last was made, and the beetle in order to make its way out had to eat through the lining sheet of lead. The duration of the larval state of many longicorn beetles exceeds two or even more years, and it is, therefore, not astonishing that the beetle issued from the tank after this had been in use for eighteen months.

E. A. SCHWARZ.

A Big Blast.

The Salt Lake *Tribune* gives the following account of a tremendous blast recently set off at Salt Lake City, Utah, on the 29th of April: About 100 persons assembled at the limestone quarry, north of Warm Springs, to witness the discharge of a big blast. Stone had been quarried out so as to leave a paling 100 feet wide and over 100 feet high. This face was nearly perpendicular, but had a bench or step extending up from the base forty feet. From this point a tunnel was run in on the dip of the ledge forty-three feet, and at the lower end a crosscut forty-three feet long was made. At each end of this crosscut a well was sunk nine feet deep, bringing the bottom about on a level with the floor of the quarry. In one of these wells 100 kegs of powder was placed, and in the other 125 kegs. This powder was placed in bulk, and wires so arranged as to enable the two masses to be fired at the same time by electricity. The powder and the wires once in position, the wells were filled up with tamping. The manner in which the tunnel crosscuts and wells were arranged made it easy to confine the exclusive force of the powder so as to be more effective. Wires were stretched up the hill about 700 feet to a safe place, and a portable battery was carried to the spot. The crowd of spectators viewed the quarry and such features as were visible, and then retired to the valley below, 1,000 feet away, where they had a good chance to witness the explosion. Mrs. Frank Pascoe touched off the powder just at 4 o'clock by merely pressing a key of the machine, and at once the whole face of the quarry was raised and fell in an immense mass of broken rock, from the size of an egg up to that nearly of a house. Mr. Pascoe estimates that the blast brought down and loosened up between 30,000 and 40,000 tons of rock. The report of the explosion was not heavy—in fact, less than is often made by a stick of giant—but the tumbling of the rocks made the earth tremble for quite a distance. The amount of smoke which rose in an immense cloud gave some idea as to the amount of powder used, and for a time obscured the view.

Some Words to Inventors.

It is a saying attributed to the great chemist Liebig that the state of civilization of a country could be measured by the consumption of soap *per capita*. It would, we think, be a more correct generalization to infer the condition of a nation from the diversity of its industries, in which are included two important elements, namely, the extent to which it has developed its natural resources, and reduced the percentage of waste in its industries. In this last direction a rich field is open to the enterprising inventor, and we know of no more instructive book for the ambitious technologist and man of practice to read than Simmonds' "Waste Products and Undeveloped Substances," in which he will find a hundred suggestions, with latent possibilities of rich reward to inspire his zeal.

It is unnecessary to refer to books to teach the lesson we wish to convey. There is not a single industry, great or small, that is not susceptible of improvement, either in the cheapening of its processes or in the diminution of its losses by waste, and the opportunities at the disposal of the inventor who is observant enough to notice where improvement is needed, and intelligent and industrious enough to apply his time and energies to supply what is wanted, rarely fail of obtaining his reward.

We hear much about the trials and tribulations of inventors, and the fact is often paraded that not one invention in a dozen repays the cost of taking out a patent. But these things simply prove that there about the same proportion of successful inventors as there are of those engaged in other pursuits. Select a dozen men haphazard, engaged in as many different kinds of business, and it is doubtful if more than one out of the dozen is successful.

There are many who labor under the impression that luck or accident has much to do with the production of useful inventions. Nothing could be farther from the truth. There is probably no direction in which human activities are engaged where the element of chance plays a more subordinate role, or in which intelligently directed industry is more generally called into play. The history of successful inventors will testify to the fact that they have commenced by intelligently using their faculties of observation to ascertain in what direction an improvement was demanded; and that having ascertained this, they have gone to work intelligently and industriously to supply what was wanted. The unfortunate inventors are made up largely of the class that lack that most useful of commodities—common sense. They comprise the numerous visionaries who fancy themselves wiser than their fellows, and toil over such impossible problems as prepetual motion; and the more numerous class we devote their energies to the production of inventions that nobody wants. They comprise those whose ideas are disjointed, and who find, after they have wasted time, energy, and money, that some simple but insuperable obstacle interferes with their success, and which intelligent observations beforehand would have revealed. They comprise the self-opinionated persons who, though mere dabblers in mechanics, essay to make mechanical inventions that were discarded long before they were born; and who, though destitute of chemical or metallurgical knowledge, do not hesitate to attack problems that have vexed the brains of savants. Let no thoughtful, plodding student, no mechanic, master of his art, be deterred from entering the lists because of the failure of such as these, whose destiny it would appear to be to fail at everything they undertake, but rather let him profit by the lesson their failure teaches.—*Manufacturer and Builder.*

The Present Limit of Visibility.

Although there is perhaps much to be desired in the improvement of microscopic objectives, we may still consider our present state quite an advanced one. Although the present theoretical limit of visibility is fixed at 146,528 lines to the inch, we need not be deterred from *attempting* to pass this point. The limit which was accepted some years ago as the true one, although considerably lower, was quietly ignored as the angular aperture in objectives increased. It is only a few years ago that the majority of microscopists refused to believe that *A. pellucida*, which has about 100,000 lines to the inch, could be resolved, and now it is the work of beginners to do so.

But supposing 146,528 lines to be the limit, it is evident that a one-eighth or one-tenth objective with a one-half inch eyepiece is of amply sufficient magnifying power to make the lines visible to the eye, and there is therefore no need of using more. It is a good rule to follow, under all circumstances, not to use a greater power than is necessary to comfortably do the required work.—*E. Bausch.*

Corrosion of Cast Iron Pipes.

In the course of a paper read by Mr. McElroy before the Western Society of Engineers, on the causes of corrosion of cast iron pipes, the author observed that a prominent cause of corrosion is the class of materials used, and also the method of manufacture of pipes in ordinary foundries. In the first place, a cheap and easily melted pig is selected—specifications and the inspection of quality and mixture not being strict—and the castings (for convenience of handling) are generally made in greensand moulds laid at a slope of about 10 degrees from the horizontal. Impure metal is therefore run in a way that aggravates its defects. The core bars are coated with straw ropes, which may be more or less soft and loose, coated with loam more or less soft and wet, and sprinkled with sand.

If not very carefully wedged, these bars will rise; and they are seldom stiff enough to resist the upward pressure of the molten metal. The usual spring at the center for the core of an 8 inch pipe is $\frac{1}{16}$ or $\frac{1}{8}$ inch; or as much as $\frac{3}{16}$ inch with a 6 inch pipe. The metal, poured in from the upper end, first fills the lower section of the mould; and as it rises round the core to fill the upper section, its weight springs the bar upward to the extent indicated, making the casting thicker at the lower, and thinner at the upper side. The denser, hotter, and purer metal fills the lower portion; the impurities naturally floating upward to settle in the thinner metal as it cools. Here gather portions of the sand coating of the mould; while the bubbles of the metal, caused by the development of gas from the vegetable matter of the loam, and from its dampness, tend to perpetuate themselves in blisters and air cells.

The usual defects in these cheap castings are, therefore, inequality in thickness, air cells and blisters, sand holes, cold chutes from chilled metal, and mixtures of sand and iron. Such pipes are also frequently out of line, from the effect of unequal contraction. Pipes of this description are peculiarly liable to corrosion; containing as they do mixtures of metal of different densities, together with much graphite. The duration of such pipes in the ground is largely affected by the amount of disturbance they receive. If well laid at a good depth, and thoroughly backed, they may continue serviceable for many years; but their defects are likely to become suddenly prominent upon comparatively slight external interference. In favorable circumstances they may last more than 30 years; but the majority if tested after less use will show flaws that would have insured their rejection if detected when new.

Poisonous Plants and Some of their Antidotes.

It is important that all who ramble in the woods should be able to identify the poisonous plants, not only that they may avoid them, but that they may feel secure when such plants are near them. Some of the most dangerous plants which are used for medicinal purposes may be handled with perfect safety. I am not aware, on the other hand, says Wilson Flagg in the Boston *Transcript*, that any bad effects come from the internal use of the juices of either of the two poison sumacs, which cause a violent inflammation when handled by certain people. If I remember correctly, Kalm, the Swedish botanist, tried a variety of experiments with the poison dogwood. He rubbed its leaves on his face and hands, and drank a decoction of its leaves. All this was done with impunity. If I am incorrect in this statement, I would thank any reader who has a correct knowledge of the facts to set me right. I have no means, adds Mr. Flagg, of examining the source of my information. The inflammation caused by the poison ivy and the poison dogwood resembles erysipelas; but it is not dangerous. It yields gradually to a wash of a weak solution of sugar of lead. There is a popular belief that if one has suffered an attack from it he is rendered more liable to be affected by any future exposure to the baneful influence of the plant. I have reason to believe this to be an error.

Some persons are very susceptible to the poison, while others are not affected by it at all. But I have known persons who were badly poisoned in their early days who could, after becoming adults, handle the plant with impunity. An intelligent farmer, who had such experience in his own case, believed that any one who is subject to ivy or dogwood poison might counteract his susceptibility by frequently handling it. He cited his own experience as proof of his theory. Another theory is that the woods are full of antidotes to the effects of ivy and dogwood, and that the habit of many persons of occasionally chewing the ends of a pine twig is a preventive. The chewing of the tender sprouts of the common pear tree is also considered a safeguard. I mention these notions without professing any belief in them, but they may be correct. If they seem insignificant remedies, because these plants have no powerful medicinal qualities, we must consider that the two noxious sumacs do not manifest any properties of taste or smell that would lead us to suspect their poisonous nature. Dr. Rush remarks, in one of his medical essays, that it is not safe to declare that any plant is wanting in medicinal virtue on account of its deficiency in taste or smell, though he admits that the poisonous vegetables for the most part have a decidedly nauseous and disagreeable flavor. Opium is bitter, and tobacco is pungent and nauseous.

But as these properties of poisonous plants do not exist in all species which are poisonous, it is prudent for all persons who frequent the woods, either for labor or recreation, to learn how to determine upon their own safety. Now, with regard to the poison dogwood, I may say that it is not to be found in every wood, though not a rare plant. It is an elegant shrub, seldom a tree, but appearing in clumps like the common alder. The leaf is pinnate, resembling that of the American ash, but larger, and having a greater number of broad, ovate leaflets. As I have said in another essay, this tree is equaled by no other species in our woods for the splendor and variety of its autumn tints. There is more exposure to the poison ivy because it grows everywhere. There is hardly a wood or woody pasture in the lowlands that is not covered with it, and hardly an old stone wall that is not festooned with its elegant foliage. This climber resembles the Virginia creeper in its general aspect and climbing habits, and the two plants may be distinguished by their leaves. The leaf of each plant is compound, but the ivy bears only three leaflets, while the creeper has five in a whorl; hence, when one is at a loss to determine the identity of the plant, he must count its leaflets. Neither of the two poison sumacs bears a conspicuous flower or fruit. The flowers and fruit are greenish, small, and without any beauty. If one is doubtful, therefore, about the identity of a plant, he may be sure, if it bears a handsome flower or fruit, it is neither the poison ivy nor the dogwood. As there is no other plant in our woods, however poisonous as a drug, that may not be safely handled, the rule given above may insure any one's safety.

In conclusion, I would remark that I cannot regard the poison ivy as a very dangerous plant; if it were more so, we should hear of more frequent instances of its poisonous effects. As it grows almost everywhere, it is hardly possible for parties to spend half a day in the woods without frequently handling it. Some caution is, nevertheless, advisable. If I had an estate, with trees near my house which were covered with this beautiful climber, I should not remove it. I should consider how extremely small is the liability of any one to be affected by it, and that his exposure would be greater in crossing almost any rude pasture that contained any shrubbery than by visiting my grounds.

Treatment of Earache.

It is said that by the following simple method almost instant relief of earache is afforded: Put five drops of chloroform on a little cotton or wool in the bowl of a clay pipe, then blow the vapor through the stem into the aching ear.—*Med. Record.*

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IMPROVED STEAM HAMMER.

The accompanying engraving illustrates a power hammer constructed by Messrs. Breuer, Schumacher & Co. As may be seen, the frame consists of two strong uprights, whose well proportioned bases are secured to a very solid bed plate, while their upper extremities are connected by means of the wide base of the steam cylinder, and of bolts that support no stress. To give greater rigidity to the whole a few strong cross braces are placed between the uprights, which latter, like the cylinder, are strengthened by flanges. The anvil stock is completely isolated from the frame of the machine, and is mounted upon a strong piece of wood and secured in position through an aperture in the bed plate. The sides of this stock are placed obliquely with respect to the axis of the machine, the object of this arrangement being to permit the operator to easily dress the piece in one direction and flatten it in the other, without being interfered with by the uprights.

The anvil naturally has a direction corresponding to that of the stock. It is fixed firmly to the latter by dovetails and steel keys, and its faces are constructed of forged steel. The body of a hammer is a piece of forged steel of the first quality, planed, and adjusted between two guides that are arranged in such a way as to take up all wear.

One interesting peculiarity of this machine consists in the construction of the piston and its rod out of a single block of steel. The rod runs through a wide stuffing-box lined with bronze rings that can be changed with the utmost facility. The flange bolts run through the shell of the stuffing-box, and their heads are set into the base plate of the steam cylinder. These details of construction, like those of the hammer guides, have been studied with care, since upon the carefulness with which they are carried out the good performance of the machine very often depends.

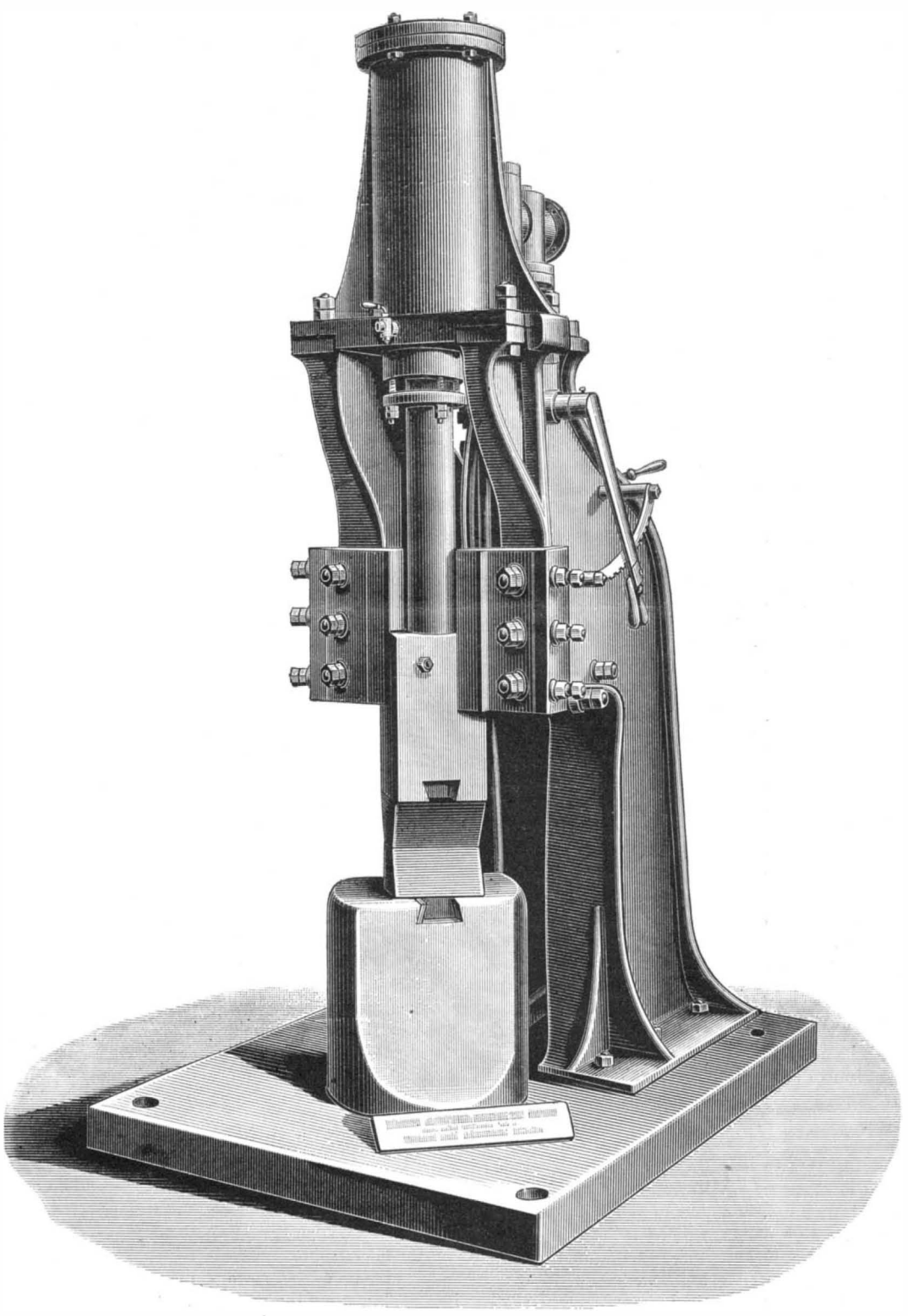
It is in the steam distributing mechanism, however, that we find the most interesting improvements. This consists in a bronze cylinder in which runs a bronze piston which is so arranged that it can be balanced. Motion is then given the slide valve by means of a bent lever which is placed in contact with a spring. While operating, the hammer communicates motion around a center of oscillation to the lever, and these motions are transmitted to the valve rod. The position of the latter's points of attack can be changed; by separating them a variable expansion is produced, while by bring them very near one another the steam is admitted under full head.

It is proper to add that the point of oscillation of the bent lever is arranged eccentrically, and connected with an external lever that permits of varying the stroke of the piston at will.

Finally, we may state that the admission of steam into the distributing box occurs through a cock whose valve is actuated by a third lever arranged between the uprights of the machine.

The use of a variable expansion in power hammers offers great advantages as regards a saving in steam, and consequently in fuel. All the operations of a forge can thus be performed without any fear of causing the pressure in the boiler to fall, as occurs in workshops where the power of the generator does not correspond to the work developed by all the machines in operation.

The type of power hammer under consideration has been more particularly devised for machine shops, railway shops, and ship yards, and for testing steel in steel works.—*Revue Industrielle.*



IMPROVED STEAM HAMMER.

MR RICHARD A. PROCTOR holds that if the full power of the arms and legs can be so applied to ingeniously arranged mechanism as to work wings more or less resembling those of a bird, there is little reason of doubting man's power of sustaining himself in the air and even traveling with great rapidity through it. Probably, he adds, it will be much easier for him to sustain himself while traveling rapidly onward than while hovering over the same spot.

Carpet Beating.

The annual domestic revolution dear to housekeepers, and known by the name of "spring cleaning," has this year, owing to the cruel easterly winds, been deferred to an unusually late period. However, during the last few days, to judge from the uproar from carpet beating, etc., arising from every backyard and adjacent mews, the process is now in full swing. We have no wish to decry this periodic purification, but merely to point out rules for its better conduct and efficiency. The usual process in households, which cannot afford to have it carried out by special agency, is first to take up the carpets, and sweep the walls and ceilings, and then to wash the floors. While the latter is drying, work must be found for the idle hands, and they cannot be better employed than in beating the carpets in the courtyard or back garden, a work attended with a horrid din and clouds of dust. It will be unavailing, we know, to complain of the noise—no appeal in this direction will gain a moment's sympathy; but we hope more attention will be paid to the other nuisance. When we reflect on the nature of the dust thus raised, we are surprised that sane persons allow to be thus stirred up under their noses all the nauseous accumulations of dining room, bedroom, and stair carpets, to say nothing of door mats, etc., into a fine dust, and which thus dispersed finds its way again into our houses in a form most readily accessible to our respiratory organs. Indeed, it is fortunate if the dust thus roused is only nauseous and not infective, since the desquamated cuticle of scarlet fever, the scabs of small pox, the dried sputa of consumptive or whooping cough patients, living parasites, and hairs from mangy cats and dogs may thus invade our rooms.

Carpet beating, we are aware, is forbidden in public thoroughfares; but it should, in any form, be prohibited within a reasonable distance of dwelling houses; and for those who cannot afford to pay the small sum required to have their carpets and mats properly cleaned, the authorities should set aside some open space, to which on stated days and at certain hours persons might bring their carpets and have them beaten, without causing annoyance or danger to themselves or neighbors.—*Lancet.*

Explosion of Brass Pipe.

We had occasion a few days ago to inquire into an accident of a kind new to us, and interesting to architects, plumbers, and others who use brass pipes for any purpose. In the present instance a piece of heavy drawn brass tubing, about three-quarters of an inch in diameter, was used to connect a hot water tank in the basement of an office building with a cold water tank on the roof. The height of the pipe was about 93 feet, and the pressure at the bottom therefore about 45 pounds to the square inch, but the metal was nearly an eighth of an inch thick, and should have been capable of withstanding with perfect safety a strain of two or three hundred pounds. The flow through the pipe was always downward, so that the temperature of the water in it was nearly constant at from fifty to sixty degrees Fahrenheit.

After the pipe had been in use about two years it suddenly gave way, the length of straight pipe tearing in long, ragged seams, in two or three places at once, and letting the water escape in a flood over the basement. On shutting off the supply it was found that so many lengths of pipe in the stack were affected that it was necessary to replace the whole. This happened in warm weather, so that there could have been no question of the freezing of the water in the pipe, and even if it had occurred in winter its situation in a building kept warm throughout, and its proximity in the basement to a steam furnace which was constantly burning, would have excluded the idea of freezing. From the testimony of the engineer of the building, and of a plumber of experience, it would appear that such mishaps are not infrequent with brass pipe, and that they are perhaps more common with the heavy than the light tubing.

The only explanation which seems likely to be well founded is that the particles of brass, in being forced over the mandrel by the enormous pressure which it is necessary to exert, are thrown into a state of internal tension, like that which exists in badly proportioned or unskillfully cooled iron castings; and that this internal tension, especially if aided by other circumstances, may determine the disruption of the pipe at any moment. In the present case, the pipe carrying only a steady flow of water, and hammering in the pipes having been carefully guarded against by air chambers, the molecular disturbance seems to have been alone responsible for the accident. It is said that the manufacturers of the tubing have learned from experience to anneal it before putting it on the market. In that case it would be very desirable for those who use it to be furnished with some rule for judging whether what they buy has been subjected to the annealing process or not. If any one of our readers can throw more light on the subject, we shall be very glad to hear from him.—*American Architect.*

Salt in Western New York.

It is estimated that the salt fields of Western New York will this year produce 900,000 barrels of the best salt manufactured, and that the production will be doubled the following year.

A few years since a well was sunk at the little village of Wyoming, on the Rochester and Pittsburg Railroad, forty miles southwest of Rochester. The diggers were looking for petroleum, but found instead a deposit of rock salt. Wells were shortly after put down in various places within a radius of 100 miles, and the results have been wonderful.

The most prominent place in this territory, perhaps, is Warsaw, Wyoming County, where there are eight wells. Solid salt is found at a distance from the surface of from 1,600 to 1,800 feet. The beds are about 90 feet thick. Dr. Guinlock is manufacturing from one well an average of 300 barrels daily. The Warsaw Salt Company manufacture 500 barrels from four wells, the Crystal Salt Company 600 barrels from two wells, and the Standard Works 100 barrels from one well. Pans are used for evaporating in all the above works except the last named, where steam kettles are employed. The industry has imparted great activity to the village, and many workmen are employed.

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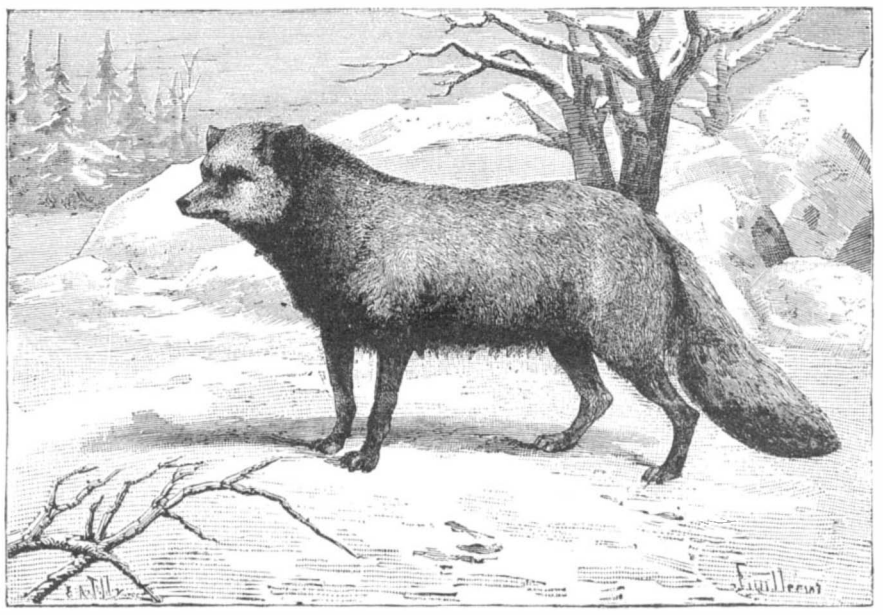
THE ISATIS, OR ARCTIC FOX.

Thanks to Mr. Delalande and Lieutenant Veron, the Museum of National History of Paris is now in possession of two representatives of a species of carnivorous animal rarely seen in zoological gardens, but the skin of which is well known to furriers. This species is the isatis, or Arctic or blue fox, known to the Russians as *Peszi* or *Pessez*, to the Greenlanders as *Terreniak*, and to the Samoyeds as *Noga*.* In zoological catalogues it bears the name of *Vulpes lagopus*, the specific name being in allusion to the presence of very thick hairs that form around the animal's feet a sort of furry shoe—an arrangement which is certainly in accordance with the habitat of this species of fox. At the present time, in fact, the isatis is confined to the Arctic regions of the two worlds, and it is only accidentally that it is met with further south, and, when it is, it must be because it has been transported thither by some iceberg, or because an exceptionally severe winter has enlarged the limits of its hunting grounds. Being destined to live in a severe climate, the blue fox had need of soft fur, a gift which nature did not refuse. The body of the isatis, indeed, is so abundantly provided with hair that the animal appears to be larger than it really is. Yet its size is notably smaller than that of our own fox, with which, however, it could not be confounded, since its paws are flatter, its body is more elongated, its head is shorter, its ears are rounder, its snout is less pointed, its tail is more tufted, and its coloring is entirely different.



THE ISATIS. OR ARCTIC FOX.

In its own country the isatis is, during summer, of a brownish, smoky, or leaden gray, or brown glossed with blue, but, in winter, of a whiteness as immaculate as that of the fields of show amid which it seeks its food. But between these two so diverse coats—the one light and the other dark—the transition does not occur abruptly, but takes place, on the contrary, by gradations, so that at the change of of seasons the animal exhibits a spotted aspect. So it is not astonishing that, on various occasions, travelers and naturalists have seen the isatis in these different costumes, and have described as different species individuals that were either in their winter or summer coat, or in a state of transition. But we now know positively that the names blue fox, white fox, Arctic fox, smoky fox, pied fox, rock fox, etc., are applied in reality to one and the same specific type.

The two specimens that are to be seen at the Jardin des Plantes were captured in Iceland, but the animal is likewise met with, and more commonly still, in Greenland, in Southern Scandinavia, in the portion of Siberia situated beyond 60° of latitude upon the banks of Behring Strait, in the Aleutian Islands, and in the northern part of the American continent, beginning at the 50th parallel. Everywhere where it is not disturbed it scarcely takes the trouble to excavate or burrow, but is content to take shelter under a rock or bush in order to sleep or watch for its prey. The latter consists principally of small mammals and birds of different kinds, of which it devours both the adult and young. It is not, however, particular in the selection of its food, and, for want of living animals, will devour such carcasses as are thrown upon the beach by the waves. Moreover, it enters with astonishing boldness the very center of the encampments of travelers and seizes not only provisions, but also bags, coverings, and woolen and skin clothing. The naturalist Steller and his companions, who were cast by shipwreck upon Behring's Island, and who had to stay there for ten long months, were obliged to suffer much from the incursions of these carnivoræ. It was in vain that they tried to drive them off by firing at them, setting traps for them, and capturing a few individuals which they afterward exposed to the eyes of their companions, for every night the foxes returned to the charge, disarranged the stones under which provisions were hidden, and gnawed gloves, shoes, hats, and even the reindeer skins which served the shipwrecked party as beds.

The isatis may, then, by good right, be considered as a noxious animal, and the war that is waged against it would be perfectly justified even though its skin had no commercial value. But the skin is valuable, however, and so the hunting of the animal has, during the last century, considerably extended. Its capture presents no difficulty, since its instinct for self-preservation is but feebly developed, and it possesses a singular mixture of stupidity and cunning, and cowardice and boldness.

It is asserted that the Ostiaks Samoyeds have no need of traps in order to capture the isatis, but proceed very simply as follows: When the ground is covered with a winding sheet of snow in winter, they start upon a campaign armed with nothing but shovels made of the antlers of the reindeer. As soon as they discover the mouth of a burrow dug through the snow they quickly ascertain its direction, open the gallery with their shovels, seize the semi-torpid animal by the tail, and dash its brains out against a rock. In other countries this animal is taken in traps or hunted for with the gun.

Mr. P. L. Martin estimates the number of isatis skins that annually reach the markets of Europe to be 90,000. These skins are of two kinds, pure white ones from Arctic America and bluey-gray ones either from Archangel or Labrador. The former are worth at wholesale 6 to 15 francs each, and the latter bring from 45 to 90, and are usually cut into strips for trimming ladies' cloaks, or are more rarely put together in such a way as to form magnificent carpets or rich coverings.

But all the skins of this kind do not reach Europe, for there is also a very important trade in them with China, which for the last century has annually imported several thousands for ornamenting the cloaks and robes of the mandarins. Some of these peltries must likewise be utilized upon the spot, and others are sold in large numbers to the United States. Finally, it is certain that many animals are massacred without profit to the industry or become a prey to eagles and gyrfalcons; so that we may, without exaggeration, estimate the number of these carnivoræ that annually disappear as 300,000. Under these circumstances the species is surely fated to extinction in a very short time, and, if it has not as yet been totally destroyed, the fact is due to its remarkable fecundity, every female giving birth each spring to eight or ten young.

Despite its limited intelligence, the Arctic fox, when captured young, is easily tamed, and shows that it is capable of being educated to a certain degree. Whatever may have been said about it, it even appears that two individuals of this species may be confined in the same cage without any trouble, since those at the Jardin des Plantes seem to live in harmony. These animals, during the exceptionally mild winter that we have just passed through, underwent no change in their coloration, but remained of a uniform gray. In Russia, on the contrary, if we are to credit Mr. Brehm, some foxes of this species that were kept in a heated room assumed their white costume at the same epoch and in as complete a manner as the wild animals living around the polar circle. Evidently there are new observations to be made upon this subject, and we trust that the specimens at the museum will live long enough to allow us to ascertain whether transportation decidedly deprives these carnivoræ of the power of modifying their coloring, according to the season.—*La Nature.*

* The Chippewyans call it *Kkas-ba*, "white beneath," and the hares *Kka-pa*, a name having the same meaning.—*Translator.*

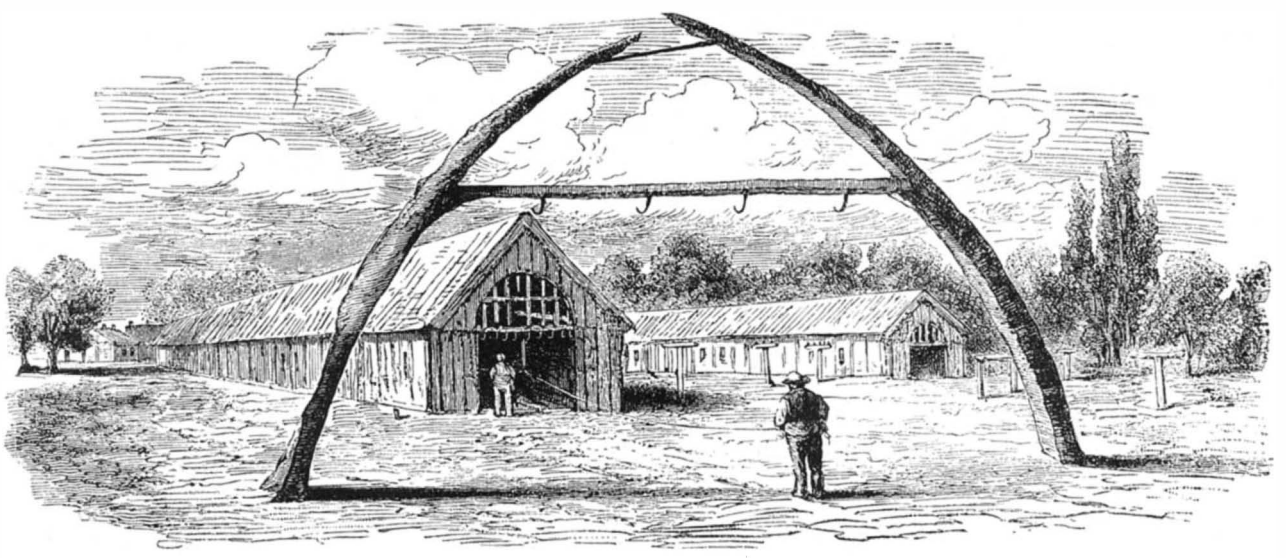
The Red Sunsets.

Mons. M. J. Jamin, a member of the Academy of Sciences, communicates to *Revue des Deux Mondes* an article on the red sunset phenomenon which prevailed in nearly every part of our globe last winter. He believes the volcanic theory, and the conclusion reached by him is that the eruption of Krakatoa was one of the most important manifestations of volcanic forces the world has known; that the magnitude of the forces then put in motion renders it entirely credible that an immense mass of volcanic ashes mixed with watery vapor was propelled from Krakatoa to a height probably almost coextensive with the limits of the earth's atmosphere; that this dense mass of fine and principally microscopic ashes floated above or on the surface of the atmosphere as oil floats on water, and that it was gradually diffused by the air currents until it had become visible over nearly three-fourths of the earth's surface. To the objection of the advocates of the cosmical theory that some traces of this volcanic dust ought to have been found on the surface of snow somewhere, M. Jamin replies by adducing evidence that it has actually been found, and at points considerably distant from one another.

He also produces a strong argument from analogy by citing the case of a similar eruption which occurred on an island in the Mediterranean in 1831. In that case the same peculiar optical phenomena were noted, and for two months red sunsets and sunrises were observed, not only in various parts of Europe, but also on the continent of America. He refers further to the contemporary accounts of that eruption of Vesuvius in A.D. 79 which resulted in the destruction of Herculaneum and Pompeii to show that the same aspect of the heavens was then visible, though naturally it was not ascribed to the true cause. The objections against the duration of the phenomena are met with careful reasoning showing the possibility of the persistent flotation of the extremely attenuated matter composing these clouds of mingled ashes and vapor. It may be said, adds the editor of the New York *Tribune*, from which we copy, that parts of M. Jamin's argument appear to conflict somewhat with Professor Nordenskjold's theory of cosmical dust, it seeming possible that the Professor's supposed meteoric dust may have been of the same nature as the volcanic ash clouds. The article is extremely interesting, carefully written, and makes a strong showing indeed for the volcanic theory, if it does not altogether settle the question at issue.

A WHALEBONE ARCH.

In former years the city of Hamburg was one of the great whaling ports of Europe; but since 1850 no whaler has sailed from Hamburg, as the business did not pay. Among the many relics of the time that whalers sailed from Hamburg the most noteworthy is the arch formed of two enormous whale jaw bones erected on the site of the former rope yards at St. Pauli. These jaw bones are quite intact, and will probably remain so for many years.



A WHALEBONE ARCH.

The annexed cut representing this arch is taken from the *Illustrirte Zeitung.*

Military Skating.

A corps of skaters is said to be attached to the Norwegian army, the members being men selected for good physique and accurate marksmanship. These skaters can be maneuvered upon ice or over the mountain snowfields with as great rapidity as the best trained cavalry, and as an instance of their speed one of the corps, it is reported, recently accomplished 120 miles in eighteen and a half hours over a mountainous country.

To prevent haystacks firing, scatter a few handfuls of common salt between each layer. The salt, by absorbing the humidity of the hay, not only prevents its fermentation and consequent heating, but it also adds a salty taste to this forage, which all cattle like; besides, it stimulates the appetite and assists their digestion, and so preserves them from many diseases.

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Industry and Veracity.

There are some virtues which seem to have a peculiar affinity for one another, each strengthening and developing the other by its own power of growth. Such are industry and veracity. Of course we cannot say that the busiest people are invariably the most truthful, but only that the tendency of industry as such is in that direction. It is true that industrial occupations sometimes offer temptations to untruthfulness, and might thereby seem calculated to retard rather than to stimulate the virtue of veracity. The inducements to prevarication in regard to the quality and quantity of goods and labor, and still more to the suppression of facts which would affect their value, are numerous and strong, and some undoubtedly yield to them.

We have, however, thoroughly learned the lesson that mutual confidence is the cornerstone of all social industries, and that truthfulness in word and deed is the only basis of mutual confidence. Truthfulness, therefore, naturally acquires a much higher rank in the minds of an industrious community than it can in any other. With us, in public estimation at least, it occupies the post of honor, and though doubtless many people infringe it in secret, none can be found bold enough to defend it. It is held as a test of noble character that a man is candid, sincere, and trustworthy, that his word is reliable and his promises secure. On the other hand, falsehood, evasion, and deceit are esteemed disgraceful, and those who deal in them are chiefly concerned lest they should be found out.

Mr. Lecky, in his History of European Morals, asserts that different ages and nations have different rudimentary virtues, or virtues upon which they lay the emphasis. Sometimes it has been loyalty to a leader, sometimes patriotism, sometimes the reverential spirit, sometimes independence, sometimes humility. Whoever in any particular community is decidedly lacking in such a rudimentary virtue is below the average of moral excellence, because he has neglected what is generally esteemed the very first element of righteousness. Our own term "common honesty" implies that this is at least one of our rudimentary virtues, without which no one can hope to rise in the scale of moral progress.

If we compare our state of things in this respect with that which exists among indolent nations of southern climes, or other thriftless communities that love ease better than labor, we shall find a marked difference. Instead of feeling vain in our fancied superiority to such people, perhaps if we compared our practical devotion to what appeals to us as the foundation of all virtue, with their devotion to something else that occupies that place to them, we might feel cause rather for self-abasement. We may rightly feel glad that we have learned the value of veracity, that our industries have proved it to be one of the foundations of all social welfare, of all true business relations, of all progress in morality and civilization. And yet, how far are some from embodying this accepted belief in their daily practice! How many are the evasions, concealments, and insincerities of which men are guilty, how many silences where truth demands speech, how many promises unredeemed, or kept to the letter, but broken in the spirit! It is for what we admit, for what we believe, for what we know, that we are responsible; and if we hold truthfulness in such high repute that we plume ourselves over others on account of it, then we are doubly blamable if we disown it in the conduct of our daily life. Increasing civilization and increasing knowledge open up to us more and more the nature and respective value of the qualities that constitute true manhood. But that manhood can only be realized by constantly infusing the knowledge we gain into our daily life, by vitalizing it in our hearts and conduct, by following closely the ideal we form, and by giving the whole allegiance of our nature to those principles which we honor in our thoughts and with our lips.—*Phila. Ledger.*

A French Wheat Cleaner.

At the recent Nice Exhibition was a machine shown by M. A. Maurel, of Marseilles. In the upper part of this machine is placed a hopper immediately over a cylindrical and open topped receiver. Horizontal stirrers on a vertical shaft work in this receiver, motion being given by bevel gearing and a pulley driven off the main shaft of the implement. The wheat to be treated is fed into the hopper and falls thence into the cylindrical receiver beneath, where it is subjected to the action of water delivered at a sufficient pressure to keep the sound wheat at the level of a discharge opening in the side of the receiver, the stones and heavy impurities falling to the bottom, and dust, chaff, etc., floating to the top, where they pass off by an overflow. The sound wheat being carried as described through an opening below the water level, is taken with the stream along a slightly inclined trunk rectangular in section, and in the bottom of which is set a series of catch plates to receive and hold any stones that may have been brought over with the wheat. From this trunk the wheat falls into the bottom of a vertical drying cylinder, after having been previously separated from a part of the water by means of a centrifugal fan. The drying columns, of which there are one or more, have perforated sides containing a series of inclined blades mounted on a vertical shaft and driven at a considerable velocity. By this means the weight is raised to the top of the first column, where it passes out by a discharge to the bottom of the second column, and is again raised, by which time the operation of cleaning and drying is supposed to be complete.

CUFF HOLDER.

The invention herewith illustrated was recently patented by Mr. H. D. Bishop, of West Hampton, N. Y. Fig. 1 shows the device in place on the sleeve, Fig. 2 is a longitudinal section, and Fig. 3 is a face view. Two thin strips of spring metal are so constructed as to form concave jaws, brought to an edge at their point of contact. The outer strip is of corrugated shape on its face between the jaws, thus forming swells upon opposite sides of the center, where it is united to the center of the other strip, which is provided with side wings that are turned over upon the outer strip. The outer strip is properly tempered so as to retain its bent form, and its spring is strong enough to hold the sleeve and

BISHOP'S CUFF HOLDER.

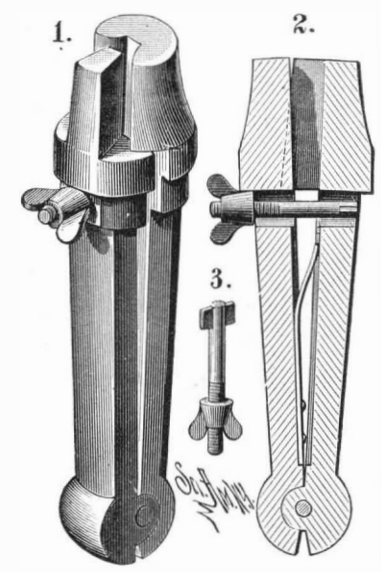
cuff between the jaws. Pressure upon either of the swells causes the depressed portion beyond the swells to bear on the under strip, there by opening the adjacent jaws to allow the entrance of the cuff or sleeve.

The device, while being cheap, simple, efficient, and easy to work, may be manufactured so as to present an ornamental appearance.

WATCH MAKER'S HAND VISE AND RING BENDER.

The main jaw is formed at one end with a cylindrical head that is so cut away as to form diverging cheeks. The opposite jaw is reduced in size at its upper end to form a nose, which closes in between the cheeks of the first jaw for grasping a wire, ring, or other object. The jaws are pivoted together at their lower ends, and between them is placed a spring by which they are forced apart. Passing through corresponding openings in the jaws is a bolt (Fig. 3), which is locked in the opening at one end and is provided at the other with a thumb nut, by turning which the jaws may be opened or closed.

When the tool is to be used for bending rings, the bolt will be removed; and in order that this may be done without taking off the nut, the head is formed with a small plate which passes through slots in the openings; the bolt is locked in



WATCHMAKER'S HAND VISE AND RING BENDER.

place in the jaws by turning it so that the plate or crosshead will be at right angles to the slots when it enters shallow recesses formed at the back of the jaw. When used as a ring bender, the tool will be placed in an ordinary bench vise, and the ring placed between the jaws, which will be forcibly brought together by the vise. Various other uses to which this tool can be put will be readily perceived.

Further particulars may be obtained from the inventor, Mr. C. B. Rubert, of Owego, N. Y.

How to Determine Expansion.

Mr. C. E. Emery made a very complete series of experiments some years ago upon the engines of the United States revenue cutters Rush, Dexter, Dallas, and Gallatin, from which he deduced the following simple rule (subject to certain limitations) for the best ratio of expansion in steam engines:

Rule—Add 37 to the steam pressure as shown by the gauge; divide the sum by 22; the quotient will be the proper ratio of expansion.

Example: An engine is running with a pressure of 90 pounds per square inch; what should be the ratio of expansion? 90+37=127÷22=5·77=the best ratio of expansion.

Temperature of the Earth at Different Depths.

At a recent meeting in this city of the American Society of Civil Engineers, observations upon the temperatures of the earth as shown by deep mines were presented by Messrs. Hamilton Smith, Jr., and Edward B. Dorsey. Mr. Smith said that the temperatures of the earth vary very greatly at different localities and in different geological formations. There are decided exceptions to the general law that the temperature increased with the depth. At the New Almaden quicksilver mine at California, at a depth of about 600 feet, the temperature was very high—some 115 degrees; but in the deepest part of the same mine, 1,800 feet below the surface and 500 feet below sea level, the temperature is very pleasant, probably less than 80 degrees.

At the Eureka mines in California, the air 1,200 feet below the surface appears nearly as cool as 100 feet below the surface. The normal temperature of the earth at a depth of 50 or 60 feet is probably near the mean annual temperature of the air at the particular place. At the Comstock mines some years since the miners could remain but a few moments at a time on account of the heat. Some ice water was given them as an experiment; it produced no ill effects, but the men worked to much better advantage, and since that time ice water is furnished in all these mines and drunk with apparently no bad results.

Mr. E. B. Dorsey said that the mines on the Comstock vein, Nevada, were exceptionally hot. At depths of 1,500 to 2,000 feet, the thermometer placed in a fresh drilled hole will show 130 degrees.

Very large bodies of water have run for years at 155 degrees, and smaller bodies at 170 degrees.

The temperature of the air is kept down to 110 degrees by forcing in fresh air cooled over ice.

Captain Wheeler, U. S. Engineers, estimated the heat extracted annually from the Comstock by means of the water pumped out and cold air forced in as equal to that generated by the combustion of 55,560 tons of anthracite coal or 97,700 cords of wood. Observations were then given upon temperature at every 100 feet in the Forman shaft of the Overman mine, running from 53 degrees at a depth of 100 feet to 121·2 degrees at a depth of 2,300 feet. The temperature increased:

100 to 1,000 feet	deep,	increase	1°	in 29 feet.
100 to 1,800 "	"	"	1°	in 30·5 "
100 to 2,300 "	"	"	1°	in 32·3 "

A table was presented giving the temperatures of a large number of deep mines, tunnels, and artesian wells. The two coolest mines or tunnels are in limestone, namely, Chanarcillo mines and Mt. Cenis tunnel, and the two hottest are in trachyte and the "coal measures," viz, the Comstock mines in trachyte and the South Balgray in the "coal measures." Mr. Dorsey considered that experience showed that limestone was the coolest formation.

Mr. Theodore Cooper gave a description of a curious slide or slump which recently occurred near Dover, New Hampshire, a large section of a clay formation having gone bodily into the adjacent river, moving trees with it, but leaving between the river and the cavity a bank of considerable width

Bleaching Sponges.

As is well known, chlorine and its compounds cannot be used for bleaching sponges, as they impart a yellow color to the latter, which in addition become hard and lose their fine texture. The method now generally employed is a water solution of sulphurous acid, and requires from six to eight days, and considerable manipulation. According to the latest researches made in Germany, the bleaching of sponges can be performed more conveniently and expeditiously by means of bromine dissolved in water. As is well known, one part of bromine requires thirty parts of water to dissolve it, and thus a concentrated solution can easily be obtained by dropping a few drops of the former into a bottle of distilled water and shaking it. The sponges are submerged in this solution, and after the lapse of a few hours their brown color changes to a lighter one, the dark red bromine solution, changing at the same time to light yellow. By treating the sponges to a second immersion of a fresh solution, they acquire the desired light color in a short time. They are improved still more if finally dipped in dilute sulphuric acid and washed with cold water. It seems strange that such closely allied bodies as chlorine and bromine should act so differently toward the coloring matter in sponges.

Cooking and Heating with Gas.

Dr. J. B. Rich, of this city (37 West 22d Street), has been conducting for some time past interesting experiments with gas stoves. The Doctor weighs the articles he bakes, boils, roasts, or otherwise cooks, and keeps an exact record of the quantity of gas consumed and the time occupied in cooking each article, or all together. The manner in which the experiments are conducted impart interest in the Doctor's investigations, and will insure, when completed, a pretty accurate conclusion as to the relative cost of coal and gas for cooking and heating purposes.

The gas stoves used in the experiments are from different manufacturers, and the Doctor has one of his own invention; but unlike most sanguine persons he does not think his stove much better than some others. But that there is vast economy in the use of gas for all kinds of domestic purposes the Doctor has not a doubt, and when through with his experiments the gas companies, gas stove makers, and the public are all to have the benefit of his investigations.

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The Colosseum.

This remarkable edifice formed the subject of a lecture lately given at the Royal Institution by Mr. Hodder M. Westropp. The vast size, massive proportions, and repetition of simple features in the Colosseum inspired us, the author remarked, with a sense of grandeur and magnificence which silenced criticism, although, as a matter of fact, there was no single feature free from blame. It was built for the exhibition of gladiatorial shows to amuse the Roman people, and was elliptical in form, consisting of the auditoria of two classic theaters, built face to face so as to permit the largest number of people seeing and hearing at the same time.

By the Romans it was considered the most wonderful structure ever erected, and this feeling of admiration continued throughout the middle ages, as the frequent reference to it by writers testified. So impressed by its size and appearance was the Venerable Bede, that he predicted that it would endure as long as Rome itself. Its name, the "Colosseum," was but a modern appellation, for it was known to the Romans as the Amphitheatrum Flavian, from the fact that it was commenced by the Emperor Vespasius Flavius. It was not, however, finished by him, having been only gradually developed in its ultimate completeness. Vespasian chose a site at the foot of the Esquiline, on the lowest level in the city, but was only able to inclose the arena and construct the three stages of seats around it. To these his son Titus added two more tiers, and dedicated the edifice with shows of the utmost magnificence in the year A.D. 80. It was finally completed in a manner which showed the tasteless extravagance of his age by Domitian, who constructed the upper portion of wood, and arranged in the arena docks, so that sea fights could be represented. In the time of Macrinus the woodwork forming the upper part was struck by lightning and consumed; it was partially restored by Heliogabalus and Alexander Severus, and early in the third century of our era was completed in stone by Gordian III.

The gladiatorial combats were continued with even greater luxuriance and waste of human life, and were not finally suppressed till 403, when an Oriental saint named Telemachus made a pilgrimage to Rome expressly to protest against these demoralizing and inhuman shows, and was, while making that protest, martyred in the arena of the Colosseum. The latest exhibition of wild beasts was in the reign of Theodoric. In 1130 the Colosseum became a fortress of the Frangipani, and in 1332 the benches were restored, and a bull fight, of which Gibbon has reproduced for us a graphic description, was held in the arena. In the fourteenth century the Colosseum was despoiled, the cramps binding the stones being cut out for the sake of the iron, and the masonry removed for building purposes, and even for burning into lime. For a time the depredations were checked, as Pope Eugene IV. granted it to the monks of the adjoining convent; but public opinion was against making it private property, and it was, after a time, resurrendered to the people. At a later period, it was again used as a quarry, and from it the palaces of the Farnisi and Barbarini families were largely built, but it was afterward again placed under the protection of the Popes, and is now national property.

The first archæological excavations in the arena were made between 1810 and 1814 by the French. They only went down some 10 feet below the surface, being deterred by the influx of water, and never reached the original floor level. In 1874–75 a fresh series of explorations was commenced by the Italian Government, at the instigation and under the direction of the late John Henry Parker. Twenty-one feet below the present level, the excavators were rewarded by discovering the original floor of the arena, with the wonderful series of substructures built upon it in the time of Commodus. Turning aside to give a general description of the building, Mr. Westropp mentioned that it was 650 feet along the major axis of the ellipse and 513 feet across, and rose, as completed, to a total height of 157 feet above the surrounding ground. This immense outer wall consisted of four stories, of which three were of Vespasian's structure, and the fourth, a loftier and very different one, represented Gordian's addition. Three stories were decorated with columns, and the upper one with pilasters, each of a different order. The columns were of equal diameter, and divided the circumference into 80 arcades on each level. That on the ground story, which was 30 feet in height, had a Doric order; the next, 38 feet high, was Tuscan; the next, also 38 feet high, was Ionic, and the upper stage, 44 feet high, which had no arcading, but instead a series of rectangular window openings, with shields between, had pilasters of the Composite order, a style which was excellently fitted for its lofty position by the boldness of its volutes and general treatment.

In the lower story seventy-six of the arches were ordinary entrances, aptly termed "vomitoria," and each bearing a distinctive number; the other four openings were reserved for the Emperor and other distinguished personages. Each voussoir in these three lower arcades had a mortise and tenon on its edge, so that they could be fitted to each other in each half of the arch, without necessitating the use of centering during construction. Behind these arches on each floor, and between the outer facade and the tiers of benches, was a spacious corridor leading to the seats, and to stair cases leading to the upper levels of the arena. Each stage was marked off by an entablature, and the whole was crowned by one of greater boldness, above which was an attic. This upper entablature was supported by brackets, and in it were pierced a series of holes through which formerly passed the ropes by which the telum or velarium, an immense curtain, protecting the spectators from the sun and rain, was drawn toward or from the mast in the center of the arena. The materials used for walling were marble and travertina for the exterior, pepinino for the internal walls, and tufa and brick for filling in. The seating was by movable wooden benches. The lowest level next the arena was known as the podium, and was protected from the animals by a low wall, and was reserved for the emperor, consuls, and other distinguished personages; above this was the mœnianum, or seats for the equestrian order; above these, those for the populace, and women were admitted to the upper gallery only. Great discrepancies existed between the statements as to the number of persons that could be accommodated in the Colosseum; but Mr. Fergusson, on a careful calculation, estimated that no fewer than 50,000 persons could be provided with seats. The excellent adaptation of the building to its purpose, and the skillful arrangements for free ingress and egress, deserved the highest commendation.

The arena itself was originally formed by Titus on the ground level, but this was found to be too low to be easily seen from the auditorium, and thus, probably in the time of Trajan, and certainly before that of Commodus, its level was raised 21 feet by means of substantial substructures, between which were left five longitudinal grooves or docks, three straight, the other two curved, which could be filled with water from a neighboring aqueduct for floating galleys upon, and also a numerous series of square pits in which were placed the cages of animals; in recesses under the podium and seating were other dens for wild beasts. The arena, as raised in the days of Commodus, had an internal diameter of 287 feet by 180 feet; it was paved with bricks over the solid substructure, and the docks and square apertures were covered in with boarding. In the central dock, during the recent excavations; part of the timber framework for raising decorations and scenery was found, and also the socket in which the velarium mast was lifted, and at one end was a drain protected by iron bars, through which the water was run off. It was evident that lifts were provided in the square holes for raising the animals' cages at the proper moment. In conclusion, the lecturer quoted descriptions of combats and pageants held in the Colosseum, and remarked upon the singular fact that, although this was one of the vastest and most greatly admired of ancient structures, the name of no architect who was concerned in its construction was known to us.

Gas in Iron and Steel.

The following is a summary of a highly interesting paper on the subject, published a short time ago by Dr. Friedrich C. G. Müller in our German contemporary, *Stahl und Eisen*, and forming a sequel to Dr. Müller's report on his previous experiments:

It is an undeniable fact that iron of every description, whether solid or liquid, and whatever the temperature may be, is possessed of the faculty of absorbing gases. This faculty applies in the highest degree to hydrogen, and in a smaller degree to oxide of carbon, carbonic acid, and nitrogen. From a series of experiments it would appear that hydrogen, the same as palladium, is able to form a sort of alloy with iron, and to exercise a very great influence on the physical properties of the metal alluded to.

Inasmuch as all iron obtained by known metallurgical processes comes into contact with the aforenamed gases while in the course of formation, it is obvious that it must necessarily absorb a larger or smaller quantity of such gases. In point of fact, gases of an undeniably combustible nature escape from it both in its liquid state and in the course of its solidification; but even after the iron has become solid and cold, gases may be extracted from it by heating in a vacuum, or by other physical or chemical methods. In each instance in which an analysis is resorted to, it points to the presence of a mixture of H, CO, N, and CO_2.

For the practical metallurgist the secretions of gas in bubble form which take place within the metal are of incomparably greater importance than the mere presence of gases or the silent emanations of gases which are invariably to be found in every smelting process. The phenomena of secretion are essentially of two kinds, viz., (1) scattering or spitting, and (2) rising. I have at all times attached great importance to this distinction, and shall continue to do so in the future, having fully satisfied myself that many fatal errors spring entirely from one of these two phenomena being taken for the other, and *vice versa*.

Scattering consists in a secretion of gas, which takes place within the liquid metal while it is cooling down to its point of solidification. In this case, as in that of a recently uncorked bottle of seltzer water, bubbles are formed throughout the liquid, and rise to its surface. While the surface of the iron remains in a liquid state, a frothing and fizzing takes place in consequence of this, but, as soon as the surface is solidified, the gases keep some minute channels open, through which they spit out particles of liquid metal. It is obvious that the bubbles which come up to the surface can do no direct harm whatever. Apart from the surface, which, of course, is not to be relied upon, there is no reason why steel of the description named should not yield sound ingots. The dangerous time is when there is but little liquid metal left, forming a narrow channel in the center of the block. If the width of this channel increases from the base upward, the block becomes dense and compact, but if it closes up at the top, the gas that escapes below must gather in larger quantities. It, therefore, stands to reason that, in casting a very restless sort of steel, it is as well to see that the casting increases in a regular way from the base upward.

In the case of the second description of secretion of gas—*i. e.*, the rising, or ascent—the well known worm tubes, which spread radially, come to a development. While, in the case of scattering, the central portions of the block are most in danger, the parts immediately beneath the surface are principally endangered by the rising. When rising takes place, a quantity of the liquid metal in the interior, corresponding to the volume of the pores, is pushed with great violence toward the surface, which is thereby raised or broken. The experiments undertaken by me have shown that the gas intercepted in the pores of the cooled down steel is still possessed of a pressure of 60 pounds to the square inch; it must, therefore, be assumed that at the moment when it escapes its pressure cannot be less than 300 pounds to the square inch. If, while cooling down, the metal be exposed to a still greater artificial pressure, the gases will not be able to escape at all.

If the shell be closed up, blocks with very dense cores are always obtained in the case of steel that rises quietly, and it is to be assumed that in such like cases a good deal of gas oozes out into the open air through the thin outer crust.

However great the difference may be between scattering and rising, both phenomena may yet be found existing side by side in one and the same piece of metal. Thus, *e. g.*, Thomas-Gilchrist steel, which is restless and spits, shows yet a certain tendency to rising. The radial channels, which are found in a horizontal position in the ordinary description of blocks, are the outcome of an exhalation of gas from the metal—which, having already been solidified, has entered upon the transition stage—and cannot, by any possibility, be looked upon as gas bubbles formed in the liquid metal and intercepted, as it were, by the process of solidification. Both the form and the arrangement of the worm tubes are calculated to controvert such a theory.

In turning out the liquid core of a partly solidified block of rising steel, a hollow body shows itself, the inside of which, though perforated, is exceedingly smooth. Hence it becomes apparent that iron does not solidify like sulphur, the inside of which shows a whole mass of pointed crystals in the liquid part, which crystals might very well intercept rising gas bubbles. While in the case of properly rising steel the metal is found perforated like a honeycomb beneath a thin non-porous crust, it is quite another thing in those instances in which the rising tendency is but slight. In these cases the wreath of pores gets more and more into the interior, and the outer crust becomes thicker and stronger in proportion. At the same time the pores are getting more and more rounded off. This much is certain, that in those cases the secretion of gas is attended and supported by the well known phenomenon of contraction, which, even in the case of absolutely dense steel, produces deep central cavities. As regards the nature of the gas to which the formation of worm tubes is to be traced, Stead's experiments have corroborated the result of mine, viz., that the pores of the refrigerated steel contain hydrogen mixed with 15 per cent of nitrogen; but, on the other hand, they contain neither oxide of carbon nor carbonic acid, or at most but traces of these; the quantity of gas brought out was in keeping with the volume of the pores, and the pressure amounted, on an average, to 60 pounds to the square inch.

All these facts go to support the proposition set forth by me, that the immediate cause of the rising—not of the scattering—is to be sought in the secretion of absorbed hydrogen and nitrogen. In reality, this is not a hypothesis, but rather a self-evident statement of facts; the more so since hydrogen has, in each instance, shown up as an integral part of the gases whenever drilling experiments have been made or an analysis of the gases given out by iron and steel spontaneously or in a vacuum has been resorted to.—*Ironmonger.*

Purification of Water by Motion.

A discovery has been made by Dr. Pehl, of St. Petersburg, which promises to have a very important bearing on many industrial processes. The water of the river Neva is very free from bacteria, having only about 300 germs in a cubic centimeter. The canals of St. Petersburg, on the contrary, are infected with bacteria, their number reaching 110,000 in a cubic centimeter, even during good weather. The same is true with regard to the conduits of water for the supply of the city. While the chemical composition of the water passing through these city conduits hardly differs from that of the Neva (by which they are supplied), the number of bacteria reaches 70,000, against 300 in the water freely taken from the river; and the worst water was found in the chief conduit, although all details of its construction are the same as in the secondary conduits. Dr. Pehl explains this anomaly by the rapidity of the motion of the water, and he has made direct experiments in order to ascertain that. In fact, when water was brought into rapid motion for an hour, by means of the centrifugal machine, the number of developing germs was reduced by 90 per cent. Further experiments will show if this destruction of germs is due to the motion of the mass of water, or to molecular motion. If this discovery of Dr. Pehl's be confirmed, it will become possible to destroy bacteria, and render a water comparatively pure simply by passing it through a centrifugal machine. The subject is of special interest to brewers, who suffer, perhaps, more than any other manufacturers, from the attacks of bacteria.

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ENGINEERING INVENTIONS.

A stock car has been patented by Mr. Henry Hess, of Canfield, Ohio. The floor of the car can be so adjusted that the animals cannot lie down, thus preventing the stronger from trampling on the weaker, and the car platform can easily be arranged for use as an ordinary cattle or freight car.

A compound to prevent the fusion of cinder has been patented by Mr. Wesley Case, of Topeka, Kansas. It consists of bicarbonate of ammonia, saltpeter, bicarbonate of soda, resin, and other ingredients mixed and used after a designated manner, to prevent the formation of clinker in the combustion of coal.

A car coupling has been patented by Mr. Charles Uebinger, of St. James, Ind. In combination with a drawhead is a spring bar beneath, with a beveled block secured to the free end of the spring and in front of the drawhead, whereby the coupling links of high and low drawheads may be guided within said drawheads.

A car coupling has been patented by Mr. Joseph F. Fairfield, of Alma, Neb. The coupling is formed of a forked drawhead, in the outer end of which a coupling pin is pivoted, the inner end of the sliding bar being connected with the locking frame on the drawhead, and the locking frame connected with a bar projecting up on the side of the drawhead, the coupling being done automatically and so the cars can be readily uncoupled.

An electric block signal for railways has been patented by Messrs. Stephen J. Swayze and John C. Lane, of Sag Harbor, N. Y. This invention covers improvements on former patents issued to same inventors, including electric locking arrangement for locking the signal until the train that set it reaches the next signal station, when the signal board of the signal next in rear will be released, indicating that the track is clear between it and the first signal ahead.

A steam trap has been patented by Mr. Robert B. Morse, of Naugatuck, Conn. This invention covers a simple and easily applied device more particularly designed for steam heating apparatus, and consists of a circular or disk valve on an axial stem at right angles to the length of a steam pipe, with such connections that, as the steam pipe expands and contracts by heat and cold, the valve will turn for opening and closing the ports for the escape of water condensing in the trap.

MECHANICAL INVENTIONS.

An oil cup has been patented by Mr. William A. Foster, of Fitchburg, Mass. This invention relates to oil cups where an adjustable valve spindle regulates the flow, and covers an attachment for holding the spindle, so it may be set for any desired rate of feed, and readily changed to a close or open feed.

A process of fastening diamonds in tools has been patented by Mr. Thomas W. Collins, of New York city. The fastening is obtained by means of metal deposited by electricity around the diamond and the adjoining parts of the tool, thus fastening diamonds firmly to the edges and surfaces of abrading and cutting tools, as stone saws, rock drills, etc.

An insertible saw tooth has been patented by Mr. William B. Risdon, of Trenton, N. J. This invention covers a peculiar construction and arrangement by which insertible saw teeth can be used in places where it is desirable to remove and replace the bits or teeth without taking the saw from the mandrel, or removing the holding spring from its seat.

A pulley belter has been patented by Mr. James N. Wilson, of Higginsville, Mo. This is a novel adjustable clamp device to clamp on a driving pulley across the face, and for running the belt on the pulley, it being especially designed for use on thrashing machines, where belts are apt to run off from being long and crooked and run at high speed.

A means for transmitting motion has been patented by Mr. Walter A. Rollins, of Wyattville, Surrey, England. Combined with a shaft having ratchet teeth on its end is a tubular bar, into which the end of the shaft projects on the other part of the machinery, with other devices, whereby motion may be transmitted in one direction in such manner that the parts can revolve independently in the reverse direction.

Improved machinery for rolling wire has been patented by Mr. William H. Jackson, Jr., of Trenton, N. J. The wire is passed through a series of rollers, and through one or more intervening furnaces, the speed of the rollers being easily regulated in such manner that it can be rolled down to a diameter of about one-eighth of an inch, instead of having to be drawn down for such sizes, as heretofore.

A pressure feeder for pulp grinders has been patented by Mr. Edward F. Millard, of Marinette, Wis. A steam or water pressure feeder or presser is contrived to so feed the wood to pulp grinding stones that the piston will be withdrawn by suction or a vacuum when the blocks are ground up, and thus avoid the use of packing, and save the cost of keeping the packing in order.

A brick machine has been patented by Mr. William S. Smith, of Dayton, O. The machine has a wheel with mould openings, a cam driven pawl for revolving the mould wheel intermittently, and plungers worked by cam driven levers, so the bricks will be made and discharged automatically, thus facilitating the manufacture of pressed bricks, and simplifying the construction of machines.

MISCELLANEOUS INVENTIONS.

An ear ornament fastener has been patented by Mr. George Krementz, of Newark, N. J. The invention covers a nut fitting on an ear wire, for holding an ear ornament, with means for clamping the nut on the wire.

A bib for children has been patented by Mr. George E. Kimball, of Franklin, Mass. The bib has on its front a pocket for a nursing bottle, so the clothes will be protected, the bottle held conveniently, and the contents not apt to be spilled nor the bottle broken.

An anchor has been patented by Mr. William Lewis, of St. John, New Brunswick, Canada. This invention covers a peculiar design for an improved anchor, one which is calculated to be simple in construction, not easily fouled, and which will readily take hold on the ground.

A harness saddle has been patented by Mr. Daniel B. Holsburg, of Granville, Ill. This invention, by a novel construction and arrangement of parts, provides to so support the thills that they will not make any side to side motion of the pad, to chafe or gall the horse's back.

An incubator has been patented by Mr. James Rankin, of South Easton, Mass. Improved means are provided whereby the water employed to maintain the required heat is also made to regulate the temperature, and maintain it automatically at a uniform degree.

A necktie fastener has been patented by Mr. Frederick Kubec, of Riverside, Iowa. It is made of two pieces of spring wire, to which the material of the necktie is stitched, the wire being so shaped as to readily hold the necktie in position without being attached to the collar button.

An eaves trough hanger has been patented by Mr. Henry J. Hoepfner, of Athens, O. The hanger is formed of a metal strap, with ends secured to a cross piece in one continuous piece of wire, which is provided with loops through which the nails or screws for fastening the hanging wire to the roof can be passed.

A thill coupling has been patented by Mr. Milton E. Campany, of Muskegon, Mich. This invention covers a peculiar construction and arrangement of parts whereby the clip is so held on the axle that rattling is prevented, and coupling and uncoupling are quickly and easily effected.

A stay roller for sliding doors has been patented by Mr. Le Grand Terry, of Horseheads, N. Y. This invention covers an improved arrangement for guiding the bottom of a sliding door, the roller being held sufficiently firm to prevent rattling, while it is permitted to revolve freely, and without undue friction.

A pneumatic lock has been patented by Mr. Alonzo W. Fuller, of Boston, Mass. In a lock with two piston cylinders, connected at their opposite ends to a bolt mechanism, is a third cylinder with an air compressing piston, connected with and operating the other cylinders and bolt by a suitable valve mechanism.

A ship windlass has been patented by Mr. Ambrose Amiro, of Pubinco, Nova Scotia, Canada. The arrangement of the brake lever and ratchet wheels is such that the brake lever ranges parallel with the drum of the windlass compactly, and affords a simple means of applying great power to the working of the windlass.

A metallic barrel hoop has been patented by Mr. Ellsworth Ford, of Westville, Conn. This invention consists of a half round metal hoop blank twisted at its opposite ends in reverse directions to engage and hold the ends firmly together, and with a rib adapted to bed itself in the wood and hold the hoop in place without nails.

A border light for theaters has been patented by Mr. John T. Preddey, of Carson, Nevada. The invention covers a cylindrical casing, with an open offset in the top, in front of which is a reflector, and in front of the reflector the casing has a hinged wire netting part or door, making a light which is safe, simple in construction, clean, and durable.

An oil cup has been patented by Mr. William H. Thomas, of Santa Ana, Cal. The patent covers such construction as will afford facility in filling the cup, free from liability to loss of filling plug or stopper, a positive lock for means for adjusting the feed, and the oil is caused to drop direct from the point of the feeder.

An improved horse power device has been patented by Mr. Homer Adkins, of Concordia, Kansas. A balanced tipping or tilting horizontal driving wheel is provided, with its whole support below, and means for tipping or tilting the same and making it run steady, lightness being combined with strength, and an easy and steady motion obtained with but little friction.

A bench dog has been patented by Mr. Riley Doty, of Leonardsburg, Ohio. It consists of a channel bar of steel of differently shaped cross section, notched transversely near the upper end to form teeth for engaging the work, and inserted in the bench at a slight inclination from the vertical, being capable of holding work firmly either flat or edgewise.

A bag holder has been patented by Mr. Herbert R. Royston, of Chicago, Ill. This is a simple contrivance of a base piece for attaching to the wall, counter, or other support, with an elastic band stretched between two points of the piece, between which band and base the package of bags is to be placed for being held so as to be pulled out one at a time as wanted for use.

A bung borer has been patented by Mr. Gustav A. Stanger, of Chester, Conn. It consists of a tapering casting with a longitudinal slot, on one edge of which is held a blade, a bottom plate on the lower end of the casting having an aperture forming a cutting end, and with a gimlet pointed screw, making a borer that catches the chips and prevents their dropping into the barrel.

A wire stretcher has been patented by Messrs. Charles S. Older and Leander L. Deering, of Independence, Iowa. Combined with a gripping device and gravity clutches is a lever, and a looped bolt forming the pivot of the lever, and with its loop adapted to receive the bar upon which the gravity clutches are arranged, so the wire is drawn up every time the lever is moved in either direction.

A cider mill has been patented by Mr. Alpheus D. Lair, of Mexico, Ind. It has two endless fabric bands passed over suitable rollers, one of which receives the pomace from the grinding mill and carries it over rollers, above which is a presser plate, the pomace afterward being carried between presser rollers, the pomace and cider being automatically separated, and the mill operating very rapidly.

A marking and shading pen has been patented by Mr. Elbert Alderman, of Portville N. Y. The working end or shading piece is made of India rubber, and by suitably holding or turning the pen in the hand it will make marks of required width for coarse or fine shading, having a steady feed and being much easier used than a brush, while making a smoother mark.

A music holder has been patented by Mr. George Burt, of Fort Madison, Iowa. The body of the holder is made of sheet metal, cut and stamped into any ornamental form, and bent at its lower end into two ears, a spring actuated clamp with slots being pivoted thereto, with spring fingers, and other peculiarities of construction, for holding music on a drum or other band instrument when marching or otherwise.

A fire alarm has been patented by Mr. Charles H. Judson, of Greenville, S. C. In combination with a wire having highly fusible connections is a spring connected with a mechanical bell ringing mechanism, several lines of wire from different parts of a house being so arranged that the melting of any one of them will give the alarm, and record the place of fire on an annunciator in the office or elsewhere.

A bailer for cleaning oil wells has been patented by Mr. James S. Moody, of Summit City, Pa. The bailer consists of a tube with a check valve at its lower end, and a steel neck and valve closing upwardly at its upper end, with a stem connected with the drill line, so a sand line is unnecessary, the gas is allowed to escape, and the bailer can be entirely filled before it is drawn out, so the well can be cleaned more rapidly and thoroughly than at present.

A simple and cheap device to lower the draught on platform wagons has been patented by Mr. Foster H. Cheney, of St. Louis, Mo. There is a broad inner and outer clevis swung from the gear at desired height or place by springs, which relieve any jerk, and permit draught strain to come on chains attached to the axle. The evener bar is firmly clamped by the inner clevis and a flat spring bar through which the evener bolt passes, so that there is no hole to weaken the wood. There is also a detachment device to quickly release the draught animals.

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Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 349.

Catechism of the Locomotive, 625 pages, 250 engravings. Most accurate, complete, and easily understood book on the Locomotive. Price $2.50. Send for catalogue of railroad books. The Railroad Gazette, 73 B'way, N. Y.

NEW BOOKS AND PUBLICATIONS.

DIE PHYSIKALISCHEN GRUNDSAETZE DER ELEKTRISCHEN KRAFTUEBERTRAGUNG. By Joseph Popper. A. Hartleben, Vienna.

This pamphlet of fifty-five pages is an introduction to the study of the transmission of power by electricity, enumerating the physical principles involved, together with their mathematical proofs.

CHAMBER OF COMMERCE OF NEW YORK, ANNUAL REPORT, 1883–84. By George Wilson, Secretary. Printed for the Chamber.

Mr. Wilson's many years' experience as secretary of of the Chamber, and the care and good judgment he exercises in compiling this record, not only of the proceedings of that body, but of the most important statistics of New York business, renders this volume an especially valuable one, making, as it does, a work unique in its way. The special trade reports cover nineteen leading articles of commerce in New York, all prepared by acknowledged authorities on the subjects treated of.

WORKSHOP RECEIPTS FOR MANUFACTURERS, MECHANICS, AND SCIENTIFIC AMATEURS. Third series. E. & F. N. Spon, New York and London.

The two former volumes of this series have been received with great favor. This one is largely devoted to electrical and metallurgical matters. The article "Electrics" explains a wide range of methods in the practical applications of electricity, and in this specialty, as well as in the department of metals, their alloys and different ways of working, the information given is brought down to the latest dates, and set forth in clear and concise language.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at the office. Price 10 cents each.

Correspondents sending samples of minerals, etc., for examination, should be careful to distinctly mark or label their specimens so as to avoid error in their identification.

(1) J. A.—Transfer paper is made by rubbing thin strong tissue paper with a composition consisting of 2 ounces tallow, ½ ounce powdered black lead, ¼ pint of linseed oil, and sufficient lampblack to make it of the consistency of cream. These should be melted together and rubbed on the paper while hot. When dry, it will be fit for use.

(2) J. M. F. writes: Can I obtain through your correspondents' column some information concerning carving in clay, additional to that contained in the SCIENTIFIC AMERICAN SUPPLEMENT, for May 29, 1880, No. 230? A. Modeling clay is any clear gray clay, or if preferred, porcelain clay moistened with water and a little glycerine. The glycerine prevents drying. There is a modeling school in the Cooper Union where you may obtain both information and instruction in modeling.

(3) C. T. B. asks: 1. How much greater, if any, is the specific gravity of water in a lake or ocean at 1,000 feet below the surface than at the surface? A. The specific gravity of water at great depths is no greater than what is due to its compressibility, which is virtually *nil*. 2. Is there a point in the depths of water at which a body whose specific gravity is just a little greater than water at the surface will, if placed in that water, cease sinking before it rests on the bottom? A. We believe

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that the theory that bodies of about the same specific gravity as water float at a certain depth is no longer held. 3. If a body whose specific gravity is less than water is submerged in the water of a reservoir, and is of such shape and so placed on the bottom of the reservoir that no water is beneath it or any part of it, will this body rise to the surface or remain at the bottom? A. It will stay there just as long as the pressure of the water is confined to its top and sides.

(4) D. & N. write: We have been endeavoring to construct a cheap barometer by suspending two air chambers (one open and the other sealed) from opposite ends of a balanced beam, with the expectation that the varying weight of the atmosphere filling the open one would cause them to rise and fall, and thus foretell the weather. The open one will go up on the approach of fair weather, but it will not go down on the approach of rain. Why does it not work both ways? A. The changes in temperature have too much influence upon the action of the barometer that you have made to make it a serviceable instrument for its legitimate purpose. In fact, we cannot see the value of the cylinder with the hole in it over a solid counter weight. The whole as light as possible; and balanced in all positions and varnished with shellac to prevent the effects of moisture that will gather upon the surface upon change of weather. The difficulty is probably with mechanical construction of your barometer; your theory is correct.

(5) J. H. R. writes: I have a hydraulic ram; the air chamber gets full of water upon an average of once in two weeks, and stops the ram. Now, is there any remedy for this? A. A hole one-eighth to three-sixteenths inch diameter at point above connection in drive pipe is said to remedy the trouble, or possibly there is a small leak about the air chamber.

(6) O. S. V. asks: 1. Are ports ¼ inch x 1 inch and exhaust ½x1 inch the right size for a cylinder 2½ x 5 inches? A. Better make them $\frac{5}{16}$ x 1½ and $\frac{9}{16}$ x 1½ inches. 2. Is a half inch pipe large enough for steam pipe for same? A. Make your steam pipe 1 inch diameter and exhaust 1½ inch diameter. 3. Is a ⅝ pipe large enough for exhaust; if not, what size should it be? What power would the engine have at 300 revolutions? A. For the power refer to rule in SUPPLEMENT, No. 253. 4. What diameter and what weight should the fly wheel be? A. Wheel 18 or 20 inches diameter, and weight about 75 pounds. 5. Will a vertical boiler 16 inches in diameter and 3½ feet high furnish sufficient steam? A. No; it should be at least 20 inches diameter and 4¼ feet high. 6. Would a plunger pump ¾ inch in diameter with 1 inch stroke driven by eccentric on main shaft feed the boiler, and what size should feed pipe be? A. No; it should be 1½ inch diameter and 3 inches stroke at least. Make pipe ¾ inch diameter.

(7) J. A. R. writes: I have an engine of the following dimensions: Cylinder is 8x14½, ports ⅝ x5, exhaust $\frac{15}{16}$ x 5; valve is 4⅝ x 6¼; travel of valve 1⅜. Now, the valve will open but $\frac{3}{8}$. Is there not too much lap? If so, shall I cut the valve down? Does the valve travel far enough? Please tell me how to fix it. A. You do not give the lap of the valve nor the width of bridge, hence we cannot say what alteration should be made, but we infer you have too much lap or too little travel, or both. 2. Steam pipe 1½ inch, a short piece 4 inches long from the governor to steam chest, 1¼. Boiler 36 inches by 10 feet, two 12 inch flues, 60 pounds of steam, revolutions 160; how many horse power? A. Your steam pipe should be at least 2¼ inches diameter. For horse power see rule in SUPPLEMENT, No. 253. 3. I want to run a saw 50 inches; diameter of fly wheel, 48 inches; what should the pulley on the saw shaft be to give 725 per minute? Or should I run engine faster? Pulley now is 20 inches. I think it is too large. Am I right? A. With pulley on saw shaft 20 inches the pulley on engine shaft should be 7½ feet diameter, or you can reduce both pulleys in proportion.

(8) Mrs. C. B. S. asks: Is not electricity visible in St. Elmo's fire, and also in the electric light in which the electric arc is *in vacuo;* or if we do not see the electricity itself, what do we see? A. It is supposed that electricity itself is invisible. Its effect on certain substances is to render them visible.

(9) H. E. D. writes: 1. I have made a pen (electric) from the directions given in SUPPLEMENT No. 166, but I can't make it perforate close enough; the spark punches a hole and then continues to go through that hole until the pen is moved a sixteenth of an inch or more, then makes another. The coil I use gives a half inch spark. A. Try less current and thinner paper. 2. How can I make a good storage battery? A. See SUPPLEMENT, Nos. 322, 301, 338, 286.

(10) B. G. W. writes: I wish to make an electric circuit to indicate when water is rising above a certain height. What terminals should I use at the water end, the idea being for the rising water to cover over the terminals and hence complete the circuit? And as the space between need be but a fraction of an inch, I suppose the resistance will be but slight, and that the wire terminals should be something that would not rust. A. Mere wire would not answer for a terminal. Use a plate of metal having an area of one or two feet, or operate a pair of metallic contacts by means of a float.

(11) J. B. G. asks how to preserve flowers so as to keep their color and brightness. Also how to preserve butterflies and other insects. A. Flowers may be preserved by immersing them in a bath of liquid paraffine. They are stirred around for a moment, so as to become completely coated with the wax. Insects and butterflies are generally preserved by placing pieces of camphor in the case in which they are kept. Sometimes insects are dipped in a strong solution of (corrosive sublimate) mercuric chloride.

(12) F. T. J. asks how calcimine is made, the different ingredients, etc. A. The process of calcimining depends largely upon the condition of the walls. If they are new, nothing further than a coat of good Paris white with just enough glue size added to bind it is required. If the work is inferior and very porous, it will require a preparation of strong size, soft soap, and a handful of plaster of Paris. Spons' Workshop Receipts, second series, devotes several pages to various receipts to be used for conditions that are likely to occur; also giving the formulas for the various colored calcimines in use.

(13) T. C. C. asks how to make heavy canvas so water tight, by painting it with some kind of oil or paint, that when anything porous is on the inside, water cannot soak through. A. Linseed oil is generally used for this purpose. See also the SCIENTIFIC AMERICAN SUPPLEMENT, No. 317, which gives descriptions of seven processes by which cloth can be made waterproof.

(14) M. S. asks: 1. What is considered to be the best speed for drills in cast iron, wrought iron, machinery steel, and tool steel? A. The speed depends upon the size of the drill and the condition of the material. The fastest speed we ever used was 1,600 revolutions for a drill of No. 18 steel wire. Machinery steel can be drilled at a higher speed than cast iron, wrought iron, or tool steel. The question cannot be answered definitely unless the size of the drill and the shape of the drill are given. 2. Does the increase twist of a drill take out the chips faster than the regular twist? A. The gain twist of a drill is an advantage in the rapid removal of chips, especially in wet work—oil or soda water. But the drill should have not only gain twist, but increased width of score to act well. 3. How much more duty does a twist drill do than the old fashioned flat drill? A. The twist drill is generally at least twice as effective as the flat drill, requiring less pressure for its work and clearing itself of chips. In some instances it will do fourfold more work than the flat drill. 4. What formula is used in designing cone pulleys so that the belt will run with equal tension on any of the corresponding steps of the cones? A. There is no definite formula. The conditions of desired diameters of largest and smallest cones and of distances of spindle cone and counter cone apart, are necessary. These being known, or at least, the distances apart being determined, lay out a scale diagram and measure the distances, which will give the length of belt. This will determine the diameters of the cones between the largest and smallest steps. It must be remembered that the "slant" or angle of a belt is different from a straight parallel line measurement.

(15) J. A. asks whether soap or ammonia would be injurious to vulcanized rubber, and also what will destroy oil or grease on vulcanized rubber without injury to the rubber itself? A. Soap would not be likely to affect the rubber; the use of ammonia would not be desirable. We would recommend you to use for the removal of the grease a weak solution of either potassium or sodium hydroxide or else ether mixed with alcohol.

(16) T. G. C. asks if slight scratches can be removed from sheet glass by any chemical. A. Ammonium hydroxide (hartshorn) will probably take the scratches off.

(17) A. R. S. asks for a receipt for making a covering or paint for a wooden aquarium, so the water will not penetrate it. A. Use a lining of melted asphaltum. A good asphaltum varnish would likewise be suitable. SCIENTIFIC AMERICAN SUPPLEMENT, No. 158, gives receipts for cements for aquariums.

(18) E. M. asks: Is there any method to your knowledge for removing freckles from skin? A. A compound consisting of two parts sulphocarbolate of zinc, 25 parts of distilled glycerine, 25 parts of rose water, and 5 parts scented alcohol, to be applied twice daily for from half an hour to an hour and then washed off with cold water, is often used for the removal of freckles. We do not recommend such applications, however.

(19) H. M. D. asks for a receipt for a perfectly black and a bright red indelible ink for marking linen with a rubber stamp. A. For the black use 16 parts of boiled linseed oil varnish, 6 parts of the finest lamp black, and 2 to 5 parts of iron perchloride, diluted with one-eighth the quantity of boiled oil varnish; it can be used for a stamp. For color, use 1 part gelatine glue, 2 parts aniline of desired color, 1 part absolute alcohol, 10 parts glycerine, 1 part Venetian soap, $\frac{1}{8}$ part salicylic acid.

(20) J. L. P. asks how he can caseharden strips of tire steel 1½ inch by ¼ inch 14 inches long. The steel is of too poor a quality to harden in the ordinary way. Can he pack say 50 strips in a box with leather, horn, or bone, heat and allow to cool gradually without opening the box until cold; then heat singly in a common forge fire, and treat the same as good cast steel in hardening? If not possible to do it by this means, what course should be followed? A. If you are making files with low steel, it is the teeth that require the most care. The plan that you have tried should accomplish the purpose with the addition of dipping the files in a saturated solution (hot) of ferrocyanide of potassium (yellow prussiate) before packing in the carbonizing material. As you say nothing about the time that you kept the work at a full red heat, we suggest that you keep up the heat longer than before; you should succeed. A few trials will give you the proper length of time for roasting.

(21) L. A. writes: A tank is full of water; the discharge pipe goes through the bottom of tank and up nearly to the top of the water, say 10 inches below the surface of the water in tank. Will the force of the discharge be increased by shortening the pipe? A. No.

(22) W. S. writes: 1. In cutting rafters, what is termed third pitch? I claim that the rafters raised one-third of the width of the building is third pitch; others say it is not. Who is right? A. One-third pitch is a rise equal to one-third the horizontal line from end to peak plumb line, or the width of the building for a single roof, or one-sixth the width of the building for a double roof. 2. If I take 8 inches on the blade of my square and 5 feet 4 inches on the tongue, will it give the bevels for a third pitch? A. Your figures in second query are not correct; 8 inches by 24 inches will be correct. 3. In drawing water from a well, over a single wheel, does a 10 inch wheel draw any harder than one 20 inches? A. A 10 inch wheel will draw no harder than a 20 inch if the axle is proportionate and in good order. 4. Is there any part or place on a locomotive drive wheel that is at rest while the locomotive is running? If so, what part? A. The part of a wheel that touches the rail is theoretically at rest with reference to the rail.

(23) E. E. P.—Common plate is unfit for lenses. Good clear French or Belgian plate, such as the large plates that are put into store fronts, if you can find a broken one or a piece at a plate glass establishment, will make a tolerably fair lens. Flats for Newtonian telescopes should be made of speculum metal. A prism is good but expensive. A lens or glass of any kind is useless for closing the end of the telescope. Use a tin cover when not in use.

(24) M. & B. ask what it is that a cow chews after having been fed. Do cattle have a "cud," or is it the food thrown back into the mouth? Do cattle ever lose their "cud"? If so, what is the remedy? A. Cattle chew their cud, which is a ball of fiber supposed to be derived from their fodder. They sometimes lose it. The remedy is an artificial cud.

(25) F. G. writes: I am a farmer. I want to build a silo of wood because of its cheapness. Expect to lay up solid walls of boards or planks 8 inches wide, and as dry as I can get. Then line this with three thicknesses of tarred paper, and finish with matched pine boards nailed on vertically. Now, the inside of these walls will rot, I fear, being so solid and air tight, and how can I prevent it? Shall I smear every board with gas tar and lime before laying? Shall I bore holes from top to bottom of the wall, and soak the whole with crude petroleum or linseed oil? What? Would any of these things flavor the ensilage, and hence the butter? A. We do not approve of wooden walls for a silo. Anything like coal tar or petroleum will give the ensilage a strong odor that is repulsive to cattle, and may flavor the products of the dairy. We do not think the proposed wooden structure and its preserving material is as cheap in the end, nor will it be as air tight as a concrete wall that can be made with hydraulic cement and gravel or small stone. A silo depends on the retention of carbonic acid gas generated by a slight fermentation for the perfect preservation of its contents from the destructive influence of the air. The gas being heavier than air settles to the bottom, filling the entire silo to the exclusion of air. Hence the necessity of making it gas tight. See Concrete Silo, in SUPPLEMENT, No. 242.

(26) W. H. asks: 1. What acids or what process to put brass through to tin or lead line the brass. A. Dip the tubes in a solution of hydrochloric acid to which zinc has been added. This solution must be rubbed in the inside of the tube; then proceed with the tinning process, for which see the article on Electrometallurgy, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 310. 2. How to mix a solution to zinc cast iron, and how to treat the castings before dipping? A. The solution as just mentioned consists of hydrochloric acid into which zinc is put. The castings are tinned, and soldered with resin.

(27) A. N. asks if all the sparrows seen in our streets are English sparrows, and if all the male birds are distinguished by the dark spot on their breasts or necks. A. All of the English sparrow stock. The males are distinguished by the dark spots.

(28) F. S. asks (1) whether there is any way of inlaying bronze or brass letters in stone except by heating process. Can it be done in a similar way to filling teeth in dentistry? A. Letters and devices cut in gems are filled with gold foil by pressure with small tools. Letters are cast and inserted in artificial stone by making the stone and inserting letters (name and address) before it sets, then finishing off the surface. Letters cut in dovetail in stone may be filled with amalgam of copper filings and mercury, which after setting may be finished with the surface of the stone. Metals may be also deposited in such cuttings by the electrotype process. 2. Is there any way of filling seams in hard wood by using fine sawdust and glue? If so, how should it be prepared to make it waterproof, as it is for a hard wood floor? A. You may fill seams in floor with sawdust and shellac varnish that will be waterproof.

(29) F. W. H.—The wire is composed of zinc, and is probably alloyed with something to harden it, such as aluminum. It is likely that it will have to be procured by special order. If we knew more of its history, perhaps we could tell more about it.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

R. M. L.—The mineralogical name for the Arkansas oil stone is novaculite. It is found at several localities in Pulaski County, at Hot Springs (there called Ouachita oil stone) and at Whetstone Mountain. The amount found is probably small, as less than $100 worth is annually sold. The stones are prepared by grinding suitable pieces on revolving grindstones.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

May 20, 1884,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Agricultural boiler, G. Patton ... 299,003
Alarm. See Fire alarm.
Anchor, W. Lewis ... 298,867
Animal shears, E. E. Stone ... 299,034
Auger, H. L. Shaler ... 298,786
Automatic brake, Smoot & Wilcoxson ... 299,031
Automatic switch, H. W. Howell, Jr ... 298,756
Badge, F. Neubert ... 299,000
Bag and twine holder, W. Wellington ... 298,806
Bag holder, H. R. Royston ... 298,894
Bale tie, wire, L. E. Evans ... 299,063, 299,064
Barrel hoop, metallic, E. Ford ... 298,962
Battery. See Electric battery.
Bed bottom, spring, L. Wildermuth ... 298,927
Bed, wardrobe, W. H. McClure ... 298,873
Bedstead, wardrobe, J. Moran ... 298,877
Belt stretcher, J. W. I. Stevenson ... 298,910
Belter, pulley, J. N. Wilson ... 298,929
Bib, G. E. Kimball ... 298,985
Billiard marking, apparatus for, R. Bateman ... 298,815
Blind slat operator, W. H. Keeran ... 298,860
Board. See Game board.
Boiler. See Agricultural boiler. Steam boiler.
Bonnet, D. Sheplie ... 299,024
Boot or shoe bottom, C. F. Glanville ... 298,844
Bottle capper, C. May ... 298,872
Bottle carrying box, T. Drummond ... 299,060
Box. See Bottle carrying box. Letter box.
Box covering and trimming machine, G. Munro ... 298,879
Box strap or band, W. Morrison, Jr ... 298,999
Brace. See Shoulder brace.
Brake. See Automatic brake.
Brake shoe, G. N. Sceets ... 298,897
Brick machine, W. L. Gregg ... 299,067
Brick machine, W. S. Smith ... 298,905
Broom, C. Douglas ... 299,059
Buckle, D. L. Smith ... 299,028
Buckle, harness, H. A. Fonteine ... 299,065
Buckle, trace, C. C. Bauder ... 298,934
Building, portable, J. S. & R. M. Simmons ... 298,790
Bung borer, G. A. Stanger ... 298,908
Burial casket, E. S. Earley ... 298,953
Burner. See Gas burner.
Button and cuff holder, combined, C. H. Lowell ... 298,993
Button fastener, J. F. Thayer ... 298,796
Button setting instrument, E. Kempshall ... 298,984
Can. See Oil can. Sheet metal can. Shipping can.
Canopy standard, Graham & Lloyd ... 298,846
Cant hook and lifting jack, combined, O. H. Mitchell ... 298,765
Cant hook or dog, A. Kennard ... 298,759
Capsule, L. A. Anderson ... 298,720
Car coupling, H. T. Beam ... 298,817
Car coupling, J. F. Fairfield ... 298,960
Car coupling, Peacock & Wallis ... 298,885
Car coupling, G. W. Smith ... 299,029
Car coupling, C. Uebinger ... 298,918
Car, dumping, R. Stone ... 298,912
Car, hand, Dunbar & Kinley ... 298,736
Car, sleeping, J. H. Doerr ... 298,951
Car starter and brake, B. F. Shakespeare ... 299,023
Car, stock, H. Hess ... 298,968
Card, playing, E. J. Levey ... 298,991
Card, wood exhibiting, Brooks & Reed ... 299,052
Carpet stretcher, F. J. Hubbard ... 298,856
Carpet stretcher, H. M. Fressly ... 299,087
Carriage bow, F. A. Wittich ... 298,808
Carriage, child's, H. C. Seely ... 298,784, 298,785
Carriage curtain strap fastening loop, H. Higgin ... 298,969
Carriage door, sliding, F. P. Stone ... 298,794
Carriage, infant's, C. W. Trow ... 298,799
Carriage top, R. H. Pfaff ... 298,774
Carrier. See Hay carrier. Trace carrier.
Cart, road, McCollum & Stran ... 298,764
Cartridge loading apparatus, W. R. Quinan *et al* ... 299,009
Casting metal, machine for making or preparing moulds for, J. Demogeot ... 298,949
Chain bar, watch, J. Hoagland ... 299,071
Chair. See Spring chair.
Check rower and corn planter, D. W. Jacoby ... 298,978
Churn, C. J. Le Roy ... 298,760
Churn, W. H. Nicholson ... 298,770
Churn cover, J. G. Pritchard ... 298,889
Cider mill, A. D. Lair ... 298,864
Cinder, compound to prevent the fusion of, W. Case ... 298,727
Clamp. See Saw clamp.
Clevis, draught, F. H. Cheney ... 298,947
Clutch, H. Schweitzer ... 298,780
Clutch, friction, M. C. Johnson ... 298,979
Cock, or filtering faucet, hydraulic, A. Hallowell ... 298,750
Coffee pot attachment, R. A. Holt ... 298,973
Collar, F. Beiermeister, Jr ... 298,722
Collar fastening, horse, I. P. Hoff ... 298,754
Cores, machine for making green sand, J. Scull ... 298,902
Corn shelling machine, hand, L. Blue ... 298,937
Coupling. See Car coupling. Fence wire coupling. Thill coupling.
Coupling pin, J. C. Murray ... 299,083
Cultivator, G. W. Brown ... 298,822
Cultivator, tongueless, J. J. McClen ... 299,081
Cupola furnace, Clapp & Griffiths (r) ... 10,481
Curtain roller, H. H. Bryant ... 298,824
Cutter. See Stalk cutter. Wire cutter.
Dental engine angle attachment, A. Weber ... 299,040
Detector. See Time detector.
Diamonds in tools, fastening, T. W. Collins ... 299,055
Ditching machine, F. Plumb ... 298,887
Door check, J. J. Lamb ... 298,989
Door check, pneumatic, J. A. Sherman ... 298,787, 298,788
Door securer, Franke & Peters ... 298,964
Door spring, P. McAleer ... 299,090
Doors, stay roller for sliding, L. Terry ... 298,914
Draught equalizer, T. Pates ... 298,773
Drier for fruit, etc., F. M. Travis ... 298,916
Drill. See Seed drill.
Drilling machine, coal, L. P. Moran ... 298,766
Dyes from the aromatic diamines, obtaining brown, P. Monnet ... 298,998
Ear ornament fastener, G. Krementz ... 298,987
Earring, H. G. Mackinney ... 298,762
Eaves trough hanger, H. J. Hoepfner ... 298,970
Educational purposes, figure, map, and chart for, M. E. Guirey ... 297,746
Electric battery, O. Milliard ... 298,997
Electric machine, dynamo, T. A. Edison ... 298,754, 298,755
Electric machines, operating dynamo, T. A. Edison ... 298,956
Electric motors and dynamo electric machines, armature for, Vetter & Putnam ... 298,922
Electric multiple switch board system, T. N. Vail ... 299,099
Electrical conductor covering, F. S. Harrington ... 298,751
Electrotype or stereotype plates, mortised wooden block for, Ringler & Alfeld ... 299,012
Elevator. See Skid elevator. Water elevator.
Enameling metal for jewelry, etc., N. A. Buhle ... 299,054
End gate, wagon, I. Cruzan ... 298,831
End gate, wagon, G. W. Hurd ... 298,857
Engine reversing gear, W. A. Clarke ... 298,826
Exercising, striking bag for, A. B. Rumsy ... 299,091
Eye bars, manufacturing, W. Hainsworth ... 298,748
Eyeglasses, E. Goldbacher ... 298,744
Eyeleting machine, G. O. Schneller ... 299,019
Fanning mill, Kendrick & Van Duzee ... 299,077
Faucet for bottles, vent, G. W. Clark ... 298,948
Fence, B. F. Ford ... 298,961
Fence rod, W. G. Howell ... 299,072
Fence wire coupling, W. M. Clow ... 298,827
Fertilizer, B. C. Briggs ... 298,989
Fiber, machine for converting wood into, Hayden & Sleeper ... 298,851
Filter press, S. H. Johnson ... 298,758
Finger ring, R. Brettner ... 299,051
Fire alarm, C. H. Judson ... 298,971
Firearm, breech-loading, P. & C. Kaul ... 298,982
Fire escape, S. Beltz ... 298,723

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Fire escape, J. H. Bowley 298,725
Fire extinguisher, G. W. Taylor *et al* 299,036
Fireproof fabric, H. W. Johns 298,757
Flask. See Mould flask.
Flushing apparatus for closets and urinals, H. C. Weeden 298,805
Fork. See Hay fork.
Frame. See Printing and vignetting frame. Stacking frame. Umbrella and parasol frame.
Fruit jar cover, A. F. Wilson 299,044
Furnace. See Cupola furnace. Hot air and steam generating furnace. Skelp heating furnace.
Furniture, knockdown, J. B. Brolaski 298,821
Game board, J. M. Lewis 298,992
Game counter, F. Dayton 298,835
Gas burner, A. B. Lipsey 298,868
Gear, driving, Robb & Schleicher 299,013
Glass pot, Otto & Fox 298,772
Grain mixing machine, J. L. Sheppard 298,904
Hame fastener, O. E. Baker 298,814
Handle. See Pocket knife handle.
Hanger. See Eaves trough hanger.
Harrow and cultivator, G. H. Johnson 298,858
Harrow, disk, G. G. Crowley 299,057
Harrow, wheel, E. F. Stoddard 298,911
Harvester, H. A. Howe 298,854
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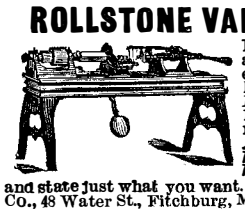
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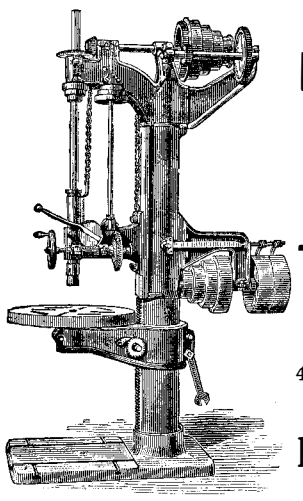
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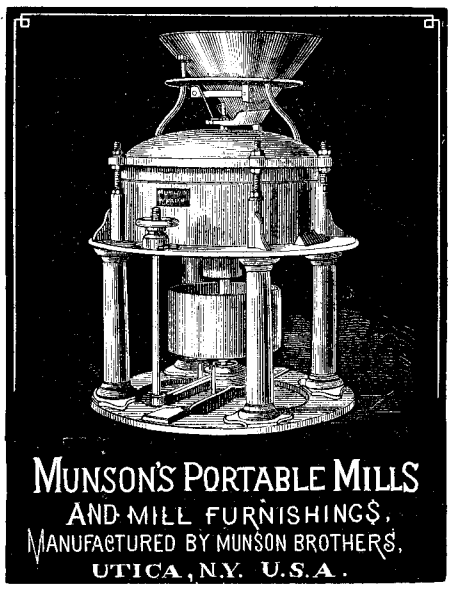
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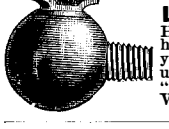
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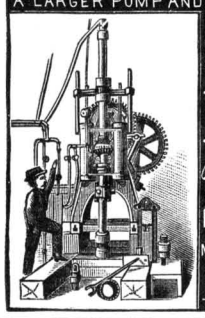

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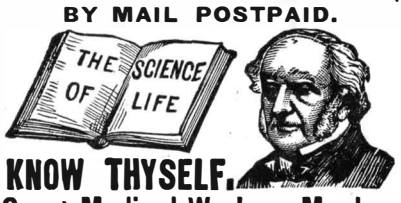

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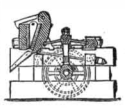

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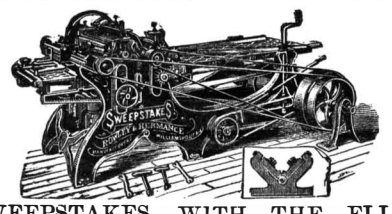

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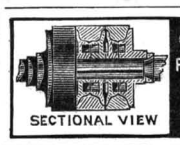

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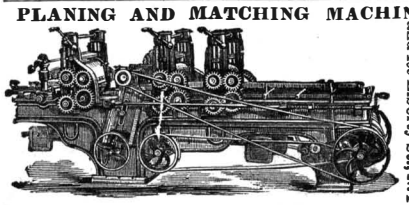

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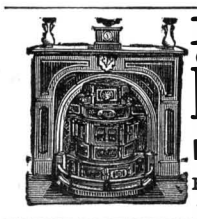

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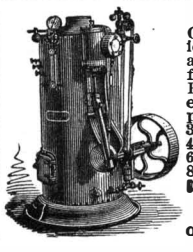

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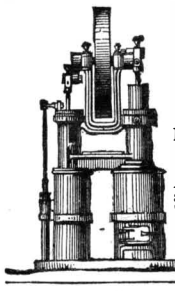

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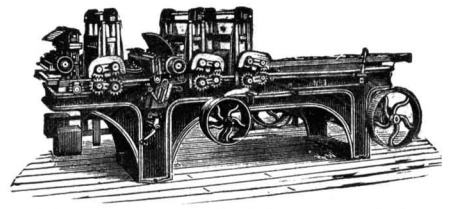

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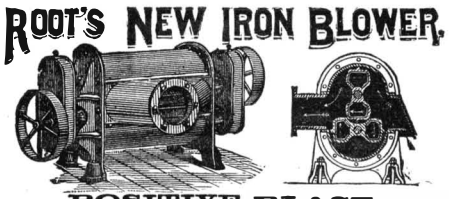

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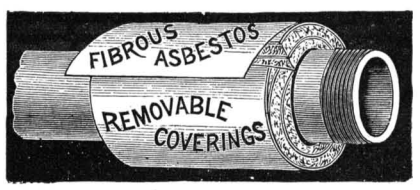

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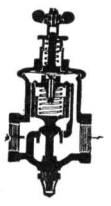

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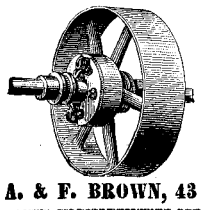

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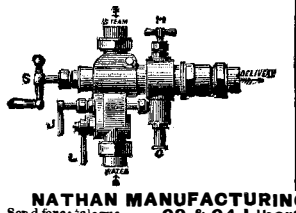

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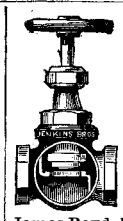

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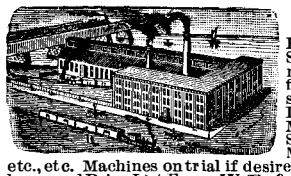

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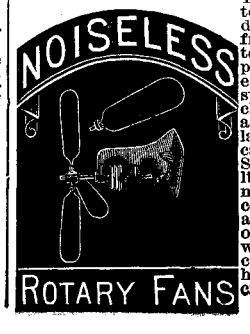

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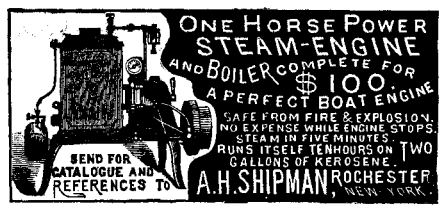
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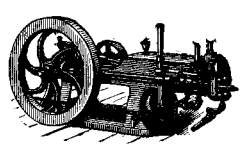

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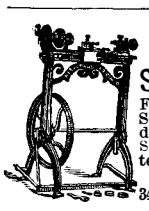

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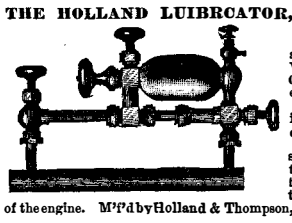

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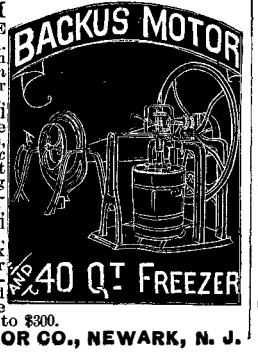

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